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ENERGY

No. 17

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1979 UKRAINIAN COAL PRODUCTION STATISTICS REPORTED

Kiev UGOL' UKRAINY in Russian No 4, Apr 80 pp 45-47

[Article: "Ukrainian SSR Coal Industry in 1979"]

[Text] In the socialist competition for early fulfillment of the assignments of the 10th Five-Year Plan the collectives of the leading mines, open pit mines, enrichment plants, sections and brigades have achieved high production results. By the Day of Miners 29 mines, 184 sections and 352 brigades had completed the four-year plan for coal extraction.

Table 1

Production associations	Coal extraction thous.T	Number of active working faces	Mean active line of working faces, km	Mean monthly advance of active working faces, m	Daily load, T	
					on active face	on open pit mine (adm.un.)
Donetskugol'	21,516	195	33.68	29.4	327	2882
Makeyevugol'	15,043	142	22.09	30.8	318	2813
Krasnoarmeyskugol'	12,778	82	12.82	42.2	475	3439
Dobropol'yeugol'	10,858	44	7.42	60.3	772	3567
Artemugol'	11,067	237	23.81	28.9	137	2064
Ordzhonikidzeugol'	6,160	105	11.48	30.2	172	1771
Shakhterskantratsit	11,936	111	18.72	30.1	314	1830
Torezantratsit	11,076	98	15.36	29.7	324	1920
Voroshilovgradugol'	11,620	75	12.17	40.2	431	3044
Stakhanovugol'	8,862	120	18.95	25.0	216	1419
Pervomayskugol'	9,156	91	16.92	24.4	298	1690
Krasnodonugol'	8,530	52	7.92	44.1	442	2552
Donbassantratsit	22,150	162	26.77	32.5	396	2690
Sverdlovantratsit	9,136	41	6.57	52.4	656	2099
Pavlogradugol'	9,497	61	8.36	56.3	522	3150
Ukrzapadugol'	15,080	100	12.74	46.9	494	2076
Aleksandriyaugol'	10,242	12	0.94	61.2	823	4075
Ukrainian SSR Ministry of the Coal Industry	204,707	1,728	256.73	34.2	339	2414

However, a number of enterprises have operated below their potentialities, and have not guaranteed the fulfillment of the plans for coal extraction and socialist commitments.

In 1979 coal extraction in the republic reached 204.71 million T which is 98.6% of the plan. Table 1 presents information on coal extraction, the number of active working faces, the mean active length of them, the mean monthly advance of the active working faces, and the load on the longwall and the open pit mine (administrative unit) for the production associations and the Ukrainian SSR Ministry of the Coal Industry.

During the examined period the enterprises of the coal industry were re-equipped on the basis of complex mechanization and automation of the production processes, updating of the technological equipment, and elimination of tight places. Thus, the number of comprehensively mechanized working faces in 1979 rose to 531 on beds with angle of incidence to 35° and up to 59 on beds with angle of incidence over 35°.

Table 2

Producation associations	Comprehensively mechanized faces equipped with combines and graders on beds with angle of incidence up to 35°			
	Number	Extraction, thous. T	Level,%	Load on longwall, T per day
Donetskugol'	49	9636	46.3	592
Makeyevugol'	39	7439	53.7	597
Krasnoarmeyskugol'	51	8290	71.0	534
Dobropol'yeugol'	32	8361	83.5	893
Shakhterskantratsit	22	3126	27.0	474
Torezantratsit	44	6331	63.8	475
Voroshilovgradugol'	28	6044	60.8	678
Stakhanovugol'	18	2024	26.8	407
Pervomayskugol'	18	2816	35.9	532
Krasnodonugol'	27	6221	89.3	636
Donbassantratsit	42	9556	47.8	665
Sverdlovantratsit	36	8075	94.6	737
Pavlogradugol'	53	8473	93.4	564
Ukrzapadugol'	60	11384	78.0	633
Aleksandriyaugol'	12	2786	100.0	823
Ukrainian SSR Ministry of the Coal Industry	531	100,562	60.8	612

Table 2 presents data on the number and effectiveness of operation of the comprehensively mechanized longwalls working beds with angle of incidence up to 35°. During the examined period almost two-thirds of the coal was produced from the comprehensively mechanized working faces. In the longwalls equipped with grader units and on the beds with angle of incidence up to 35° 6 million T of coal were extracted.

Table 3

Production associations	Making of preparatory drifts					
	all			stripping and preparing		
	Plan, km	Act. km	% of plan	Plan, km	Act. km	% of plan
Donetskugol'	294.0	299.8	102.0	213.0	215.6	101.2
Makeyevugol'	218.2	218.8	100.3	150.2	150.4	100.1
Krasnoarmeyskugol'	169.5	162.9	96.1	149.9	136.8	91.2
Dobropol'yeugol'	183.0	194.9	106.3	124.0	124.8	100.6
Artemugol'	327.0	329.9	100.9	165.5	165.6	100.1
Ordzhonikidzeugol'	123.2	131.2	106.5	72.7	72.8	100.1
Shakhterskantratsit	147.5	149.6	101.4	98.0	98.3	100.3
Torezantratsit	132.0	138.9	105.2	86.5	90.0	104.0
Voroshilovbradugol'	177.0	178.8	101.0	102.5	101.8	99.3
Stakhanovugol'	214.0	200.8	93.8	124.0	115.3	93.0
Pervomayskugol'	163.0	141.8	87.0	115.5	96.9	83.9
Krasnodonugol'	123.5	122.1	98.9	84.5	80.7	95.5
Donbassantratsit	272.3	266.4	97.8	148.6	141.3	95.1
Sverdlovantratsit	108.0	109.9	101.7	74.0	74.0	100.0
Pavlogradugol'	119.7	118.0	98.6	114.7	109.7	95.6
Ukrzapadugol'	140.0	140.2	100.1	119.4	120.4	100.8
Aleksandriyaugol'	31.5	26.7	84.8	29.0	24.4	84.1
Ukrainian SSR Ministry of the Coal Industry	2943.4	2930.7	99.6	1972.0	1918.8	97.3

The volume of mechanized extraction also rose on the beds with angle of incidence over 35°--here in the comprehensively mechanized working faces, mainly equipped with tunneling machines, almost 3 million T of coal were extracted.

A lot of attention has been focused on an increase in the volumes and rise in the level of mechanization of the preparatory work. In the mines of the republic in 1979 17.4 km of preparatory drifts more were made than in 1978. As is apparent from table 3, a number of production associations successfully coped with the annual program for tunneling preparatory drifts. However, due to the unsatisfactory work of individual collectives the plan for making drifts as a whole for the Ukrainian SSR Ministry of the Coal Industry was not fulfilled. As is apparent from table 4, despite the growth in the volume of combine tunneling it still is insufficient.

Table 5 presents data on the work of the coal enrichers of the republic. In 1979 at the enrichment plants of the Ukrainian SSR Ministry of the Coal Industry 132.9 million T of coal was processed and 79 million T of concentrate were produced. On the units of mechanized sorting 11 million T of coal were processed. The output of coal of medium and large classes was 24.2 million T, including 17.6 million T of anthracites. More coal briquets were manufactured and fewer lignite briquets than planned.

Table 4

Production associations	Making of preparatory drifts with mechanized loading of coal and rock				
	Plan, km	Act. km	% of total length of making drifts where loading is required	by combines	
				Plan, km	Act. km
Donetskugol'	237	237.1	79.1	82.0	77.5
Makeyevugol'	156	156.9	75.1	48.0	50.8
Krasnoarmeyskugol'	124	123.2	75.6	43.4	39.5
Dobropol'yeugol'	172	187.2	96.0	118.0	131.3
Artemugol'	161	157.9	100.0	13.0	6.3
Ordzhonikidzeugol'	69	69.0	94.9	3.0	0.5
Shakhterskantratsit	96	93.5	62.5	23.0	24.5
Torezantratsit	84	87.7	65.1	8.5	5.2
Voroshilovgradugol'	124	124.0	79.4	24.0	24.0
Stakhanovugol'	145	141.2	81.6	4.8	3.5
Pervomayskugol'	115	83.6	62.7	16.0	9.6
Krasnodonugol'	90	82.7	84.6	23.3	18.7
Donbassantratsit	142	123.6	53.2	13.0	7.9
Sverdlovantratsit	72	72.0	65.5	5.0	1.0
Pavlogradugol'	119	114.2	97.0	114.0	110.4
Ukrzapadugol'	116	116.0	82.9	66.0	66.0
Aleksandriyaugol'	27	21.9	82.0	27.0	21.9
Ukrainian SSR Ministry of the Coal Industry	2049.6	1991.7	77.5	632.0	598.6

Table 5

Production associations	Processing of run-of mine coal at EP*, thous. T	Output of concentrate, thous. T	Yield of concentrate, %	Output of large-medium sorts, thous. T	
				coal	anthracites
Donetskugol'	2,648	797	30.1	562	-
Krasnoarmeyskugol'	650	494	76.1	122	-
Dobropol'yeugol'	779	411	52.8	106	-
Shakhterskantratsit	4,072	1,616	39.7	-	1966
Torezantratsit	10,772	4,656	43.2	-	3831
Donetskugleobogashcheniye	56,336	38,874	69.0	3,148	1109
Pervomayskugol'	3,546	1,488	42.0	1,488	-
Donbassantratsit	22, 657	10,921	48.2	-	8204
Sverdlovantratsit	6,055	2,465	40.7	-	2466
Voroshilovgradugleobogashcheniye	25,403	17,275	68.0	715	-
Ukrzapadugol'	-	-	-	467	-
Ukranian SSR Ministry of the Coal Industry	139,920	78,997	59.4	6608	17,576

*Enrichment plant

In 1979 in the coal industry of the republic 105 extracting brigades worked with load on the longwall of 1,000 T of coal per day and more; they produced over 56.4 million T of coal. The highest results in the socialist competition were attained by the leading collectives of N. N. Skrypnik (mine/administration imeni Frunze), A. D. Polishchuk ("Trudovskaya"), V. N. Pikhterev (imeni Abakumov), G. I. Motsak (mine/administration imeni Kosmonavty), P. A. Kaminskiy ("Butovka-Donetskaya"), V. M. Borisenko (mine/administration imeni Lenin), V. I. Ignat'yev ("Krasnolimanskaya" imeni 50th anniversary of the Great October Socialist Revolution), S. I. Smolov (imeni 25th CPSU Congress) and others. The following tunneling collectives labored successfully: I. N. Naumov (mine/administration "Znamya kommunizma"), V. G. Vendilovich (imeni Abakumov), D. G. Khomich ("Chervona zirka"), N. Ye. Stepin ("Krasnolimanskaya" imeni 50th Anniversary of the Great October Socialist Revolution), I. P. Kushnarev ("Removskaya"), V. M. Vernigorov ("Pavlogradskaya") and others.

The planned volume of state capital investments was assimilated on the whole for the Ukrainian SSR Ministry of the Coal Industry by 97.0%, including the plan for construction-installation work by 98.0%; for objects of production purpose the plan for assimilation of capital investments was fulfilled by 98.0%, including the plan for construction-installation work by 99.7%. In 1979 production facilities for extraction of 5.6 million T of coal per year were put into operation. The first phases of the mines "Zapadno-Donbasskaya," No 6/42 and "Zapadno-Donbasskaya" No 16/17 of the association Pavlogradugol' with rated annual output of 1.5 million T of coal each, and the mine "Novomirgorodskaya" of the association Aleksandriyaugol' with rated annual outpuf of 1.4 million T became active. An increase was achieved in the outputs due to the reconstruction of the active mines: "Novo-Butovskaya" of the association Makeyevugol'--by 0.78 million T, imeni Vakhrushev of the association Donbassantratsit by 0.35 million T, and "Krasnyy partizan" of the association Sverdlovantratsit--by 0.07 million T per year.

The central enrichment plant "Chervonogradskaya" with output of 9.6 million T of processed coal per year was put into operation.

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FUELS

RESULTS, PLANS FOR UKRAINE OIL AND GAS EXPLORATION

Kiev NEFTYANAYA I GAZOVAYA PROMYSHLENNOST' in Russian No 1, Jan-Mar 80 pp 7-9

[Article by A.M. Paliy and V.G. Dem'yanchuk, Ukrainian SSR Ministry of Geology: "Results of Geological Exploration for Gas and Oil in the Ukrainian SSR in 1979 and Basic Directions for Its Development in 1980"]

[Text] In 1979, geological exploration work was carried out in three gas- and oil-bearing regions: Dneprovsko-Donetskiy, Karpatskiy and Prichernomorsko-Krymskiy.

A considerable amount of fundamentally important geological data that are indicative of prospects for finding gas and oil in the Lower Carboniferous complex were obtained in the Dneprovsko-Donetskaya depression. Five gas condensate deposits that were confined to Carboniferous sediments were found in this region.

Prospects for finding gas and oil in the Lower Carboniferous strata were strengthened in the Talalayevsko-Anastas'yevskaya zone. The Nikolayevskoye gas condensate deposit was discovered there, and when Well No 1 was tested gas and gas condensate yields of 58,200 and 28.8 m^3/day, respectively, were obtained from the Lower Vizeyskiy horizon. In the Anastas'yevskoye deposit, the oil yield from Well No 30 was 1985 m^3/day from the Upper Vizeyskiy sediments.

The Lutsenkovskoye gas condensate deposit was discovered on the southeastern side of the Srebnenskaya depression. In Well No 1, gas and gas condensate yields of 50,500 and 27.5 m^3/day, respectively, were obtained from the Upper Vizeyskiy strata through an 8-mm connecting pipe. In the Slobodskaya area, an oil yield in industrial amounts was obtained from the Vizeyskiy sediments by parametric Well No 321.

In the Yablunosvskoye deposit, which is confined to the Zhdanovskaya depression, the drilling of Wells Nos 2 and 3 confirmed the high promise of finding industrially exploitable amounts of gas in the Tournaisian stage. The wells revealed a thick band of gas-saturated sandstones. These data and the previously discovered Koshevoyskoye and Tarovskoye deposits enlarge considerably the prospects for finding deposits of hydrocarbons in the Tournaisian complex of the Zhdanovskaya depression, as well as in other depressions in the Dneprovskiy graben.

The Berezovskoye gas condensate deposit, which is confined to the Serpukhovskiy stage, was discovered inside the Kotelevsko-Berezovskaya zone. These sediments were tested with Well No 31 and a gas yield of 425,500 m^3/day was obtained with a 12-mm diaphragm. In the Kotelevskoye deposit, testing of the deeply buried Vizeyskiy complex produced a gas yield of 859,000 m^3/day, while when a 10-mm diaphragm was used the yield was 433,000 m^3/day. The reservoirs are sandstone with 6-10 percent porosity and a permeability rating of 2-49 md. This discovery is of fundamental importance for expanding searches for hydrocarbons in deep-lying sediments.

Important results were also obtained in the Sakhalinskaya and Belousovskaya areas, which are located to the east of the Kotelevsko-Beresovskiy rampart. Well No. 1.6 in the Sakhalinskaya and Well No 1 in the Belousovskaya structures revealed a number of highly promising gas-bearing beds in the Lower Bashkirskiy and Serpukhovskiy sediments.

In the Mashevsko-Shebelinskiy gas-bearing region, a considerable amount of new data on the gas content of the Carboniferous sediments was obtained. Interesting materials that made it possible to define more precisely the structure of the deposits and their reserves were obtained in the Raspashnovskoye deposit through the drilling of Wells Nos 16 and 17 and experimental-industrial exploitation. In the Chervonoyarskoye deposit, which is confined to a tectonic block in the northern framework of the Krestishchenskiy stock, Well No 6 produced a gas yield of 130,000 m^3/day from the Lower Permian and Upper Carboniferous sediments, using a 20-mm diaphragm.

The Korobochkinskoye deposit, the basic productive horizon of which is the Lower Vizeyskiy sediments inside two arches--Korobochkinskiy and Rtishchevskiy --was discovered in the southeastern part of the Dneprovskiy graben's northern edge. For Well No 2 in the Korobochkinskiy arch the gas yield was 389,000 m^3/day, while for Well No 1 in the Rtishchevskiy arch it was 485,000 m^3/day with a 14-mm diaphragm.

In the Muratovskaya area on the northern fringes of the Donbass [Donets Coal Basin], Well No 7 confirmed the presence of gas in the Carbonaceous sediments of the Upper Serpukhovskiy substage.

The drilling of parametric Wells Nos 414-Doroshevskaya and 445-Tsymbalovskaya has confirmed the high prospects for finding gas in the Upper Serpukhovskiy and Upper Vizeyskiy sediments in new regions in the southern and northern boundary zones of the DDV [expansion unknown].

In the Karpatskaya gas and oil province, searches for deposits of hydrocarbons were carried out in the Bil'che-Volitskaya and Pokutsko-Borislavskaya zones, as well as in the Volyno-Podol'skaya area.

In the Bil'che-Volitskaya zone in the Susolivskaya area, which is located in the northeastern wall of a prefault syncline, new data were obtained that are indicative of the enlargement of the gas-bearing area there. Well No 2 produced a gas yield of 70,000 m^3/day from Lower Sarmatian sediments, and gas-saturated beds were discovered on the basis of data obtained by the drilling of Well No 3 and geophysical investigations. The Niklovichskoye gas deposit has been discovered in this zone. Well No 10 produced a gas yield of 20,500 m^3/day from Lower Sarmatian sediments, using a 4-mm diaphragm. A new gas pool was discovered in the Lower Dashavskiy horizon in the Zaluzhanskoye deposit. Well No 42 was used to test these sediments, and a gas yield of 22,600 m^3/day was obtained with a 4-mm diaphragm. In the Mrynychskaya area these sediments were tested with Well No. 2. A gas yield of 20,300 m^3/day was obtained with a 4-mm diaphragm.

Exploration work has been completed in the Lukvinskoye gas and oil deposit in the Pokutsko-Borislavskaya zone and the gas content of the Menilitovyy sediments of the Severo-Maydanskiy block has been evaluated.

In the Chechva area, Well No 1 was used to test the Menilitovyy sediments during the drilling process and an oil flow was obtained. Sandstone saturated with hydrocarbons were raised from a depth of 5,232-5,296 m in the Menilitovyy sediments of the folded-under wall of the Nizhnestrutinskaya fold in the Rozhnyatov area, while lower along the profile Strutinskaya fold sediments were discovered that, according to data obtained by drilling and field geophysical studies, have been evaluated as being saturated with gas and oil. In the Menilitovyy sediments in the Yuzhnyy Monastyrets area, Well No 1 revealed an oil-saturated bed. These data make it possible to evaluate the prospects for finding gas and oil in Paleogenic sediments of deep-lying folds more accurately.

In the Lokachinskiy rampart, which is located inside the eastern edge of the Volyno-Podol'skaya gas- and oil-bearing area, fundamentally important data were obtained on the gas content of the Devonian carbonaceous and, possibly, reef-originating sediments, Well No 27 produced a gas yield of about 50,000-100,000 m^3/day from the Middle Devonian horizon.

In the Prichernomorsko-Krymskaya gas and oil province, new data were obtained on the gas and oil content of the Maykopskiy and Eocene sediments in the Fontanovskaya, Zapadno-Fontanovskaya and Slyusarevskaya areas on the Kerchenskiy peninsula and the Tat'yanovskoye gas condensate deposit in the plains region of the Crimea.

In 1980, geological exploration work in the gas- and oil-bearing regions will be performed primarily on the basis of previously accepted and scientifically substantiated areas.

In the Dneprovsko-Donetskaya depression, the basic object of the prospecting and exploration work will be regional gas- and oil-bearing Carboniferous complexes.

It is intended to search for deposits in the developed central part of the profile -- the Upper Vizeyskiy strata -- and in new productive complexes in the Tournaisian-Lower Vizeyskiy and Upper Serpukhovskiy beds. The basic zones where the work will be concentrated in the Lower Carboniferous level will be the Kotelevsko-Sakhalinskaya, Sementsovsko-Abazovskaya, Yablunovsko-Yarovskaya, Kulichikhinsko-Podlesakovskaya, Rtishchevsko-Lebyazhevskaya, Sofiyevsko-Novoselotudskaya and Sologubovsko-Progrebskaya.

Investigations of Middle Carboniferous sediments will be carried out purposefully in the Raspashnovskaya, Vostochno-Poltavskaya, Zapadno-Krestishchenskaya, Kobzevskaya and Krasnopavlovskaya areas, and incidentally with exploration of the Lower Carboniferous level in the Sakhalinskaya and Korobochkinskaya areas.

Prospecting-exploratory drilling into sediments of the Lower Permian-Upper Carboniferous productive complex will be concentrated basically in the prestock zones in the southeastern part of the depression (the Chutovsko-Raspashnovskaya zone and the Vostochno-Yelizavetovskaya, Chervonoyarskaya, Staroverovskaya, Ligovskaya, Klenovskaya, Kas'yanovskaya and Belyayevskaya areas).

Devonian sediments will be studied with the help of parametric and exploratory drilling in two sections: Gorobtsovsko-Zachepilovskiy, where gas pools have been found and there are reliable structural developments (according to seismic surveying data), and Yadutovsko-Kinashevskiy, where low-yield oil pools have been found.

More purposeful work will be done on evaluating little-studied depression zones, with primary emphasis on the Zhdanovskaya and Srebnenskaya depressions. In connection with this, in the later zone we will see the first use of the technique of concentrating parametric drilling in combination with areal-reconnaissance seismic surveying for the most rapid possible preparations of objects for exploratory drilling. In different parts of the depression, this year we are planning to drill 6 parametric wells (Gorobtsovskaya, Bragintsevskaya, Voloshkovskaya, Savinkovskaya, Zor'kovskaya and Severo-Lelyakovskaya), with a total depth of 13,300 m, within the limits of predicted traps. To a considerable degree this will make it possible to support a scientifically substantiated change in the conduct of geological surveying work and efficiently prepare a large depression zone for exploratory drilling in a short period of time.

In other regions that have not been studied very thoroughly (the Zhdanovskaya, Shilovskaya, Ordanovskaya, and Bakhmutskaya depressions), separate parametric wells will be drilled within the limits of prospective deeply buried structural ramparts (the Kamyshnyanskaya, Lysovskaya, Luchkovskaya, Pirkovskaya and Svyatogorskaya wells).

Significant amounts of drilling will be devoted to searching for and exploring gas and oil deposits in nonanticlinal traps that are located primarily in Lower Carboniferous sediments. The traps to be examined are found in zones of lithological-stratigraphic petering out (the Ostapovskaya, Abazovskaya, Rudenkovskaya and Shandrovskaya areas), are of the bioherm type (Aydarskaya, Bogatoyskaya, Novopodol'skaya, Muratovskaya) and, in the greatest number, are tectonically screened (Lesnaya, Gorobtsovskaya, Sidoryachskaya, Solonubovskaya, Korolevshchinskaya, Osnovskaya, Il'tsevskaya).

In the Karpatskaya gas and oil province, we are planning to develop exploration and surveying, primarily by the use of several methods in combination. In the Sarmatian sediments of the Bil'che-Volitskaya zone there will be prospecting and surveying in 12 areas and, in addition, in 4 areas in this zone the object of the work will be Tortonian and Mesozoic sediments. As a result, the gas and oil content of four areas (Bony, Podgaychika, Orkhoviche and Buchala) will be evaluated.

In the Borislavsko-Pokutskaya zone, it has been planned to concentrate the basic drilling work in the Chechvinskaya, Rudavetskaya, Lukovetskaya, Yuzhno-Monastyretskaya and Zavadovskaya areas. In addition, the drilling will include that of parametric wells for evaluating the gas and oil content of the Jurassic complex (Wells Nos 1-Bortyanin and 1-Podol'tsy) and the prospects for finding gas and oil in the Mesozoic and Paleogenic levels inside submerged blocks in the southeastern part of the Vil'che-Volitskaya zone (Wells Nos 1-Pal'kiv and 1-Biskov).

In the Volyno-Podoliya area we intend to study the gas and oil content of the Devonian sediments in the Markovichskaya and Semirinskaya areas inside the Lokachinskiy rampart.

In the Prichernomorsko-Krymskaya province, deep drilling will be aimed at searching for an exploring hydrocarbon deposits related to local uplifts and nonanticlinal traps in the Paleogenic and Cretaceous sediments in the Indolo-Kubanskiy trough (in the Yuzhno-Sivashskaya, Zapadno-Fontanovskaya, Slyusarevskaya, Krasnoarmeyskaya and Dubrovskaya areas); studying zones of buried, Upper Jurassic reef masses in the Vidnenskaya and Feodosiyskaya areas, searching for hydrocarbon deposits in the Cretaceous deposits on the southern edge of the Karkinitsko-Severokrymskiy trough (in the Pervomayskaya, Serednyaya, Voronkovskaya and Klepininskaya areas); studying zones where the thickness of the Lower Cretaceous deposits becomes less and the reservoir rocks taper out in the Prikarkinitskaya band of the trough and searning for hydrocarbon deposits related to lithological and deformational-depositional traps (in the Borisovskaya and Avrorovskaya areas); evaluating the prospects for finding gas and oil in the Paleozoic rocks in the central and southern parts of the Pridobrudzhinskiy trough (in the Starotroyanovskaya and Furmanovskaya areas).

The successful execution of this prospecting and exploratory work will make it possible to discover new deposits of hydrocarbons and fulfill the national economic assignment for increasing our reserves of gas and oil.

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BAKU OFFSHORE GUSHER PLACED UNDER CONTROL

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 7 May 80 p 4

[Article by Correspondent D. Melikov: "Explosion on a Drilling Rig"]

[Text] The sleeping Caspian was awakened by an explosion of improbable force. A fiery giant climbed to a height of 18 meters above the night sea. The glow could be seen as far away as Baku, even though the explosion occurred about 40 kilometers from the shore in the Bakhar deposit, where petroleum-gas well No 73 was being readied for operation after its drilling.

No 73 was drilled by foreman Akif Gurbanov's team. Tests confirmed the outstanding work of the drillers. The reinforced concrete "telescope," 5,300 meters long, did not have a single flaw. Water pumped into the well at a pressure of several hundred atmospheres was unable to find even the slightest crack. Then the well was once again filled with clay solution and prepared for the most important step--perforation. Access to the fuel had to be achieved.

At a depth of 5,200 meters the well was subjected to perforation--a salvo of 20 explosive charges. Punching through the reinforced concrete stem, the charges created channels to admit the fuel. Matters do not usually end with just a single set of charges--the bed is exploded numerous times until the deposit is finally shaken to life, and forced to surrender its fuel. But No 73 was a superproductive well. A single set of charges turned out to be enough.

A cold, wintry night was settling over the Caspian. A searchlight at the very top of the drilling rig cast a gentle glow upon the platform. No 73, which was called an ideal well by the oilmen, looked like a movie star on a filming set.

Twenty minutes after the first perforating charges were exploded, the clay solution filling the well began to overflow out of the valve, trembling slightly. It started as a weak fountain, and then it began climbing ever higher. The drilling rig's trembling was barely noticeable. And then suddenly a roar.

The powerful "compressor of the nether world" forcefully pressed the clayey liquid upward and out of the well's 5-kilometer bore hole, pounding the metallic framework of the derrick with a forceful stream, and covering everyone with a sluggish, sticky rain. Elementary arithmetic produced a fantastic figure for the pressure within the bed--more than 1,000 atmospheres, which significantly exceeded all expectations. In half an hour the elements would push all of the clay solution out, and petroleum and gas impurities would break out of the reinforced concrete casing like a genie out of a bottle. And then the drilling rig would become uncontrollable....

Al'nazim Guliyev, the chief geologist of the marine exploratory drilling administration, was in charge of the platform. He knew quite well that in such a situation, he had to do what was written down in a special instruction--immediately cut the wire line holding the perforating tool, and shut the valve tightly. In a word, he had to strangle the well. By averting ejection of the solution, he could preserve that which is the most valuable--the deposit itself, keeping it from springing a leak.

Guliyev had a few minutes left before the well turned into a real gusher, during which time he was obligated to make a decision--cut the perforator cable. But in the critical moment the chief geologist feverishly tried to contact the shore or, more accurately, his boss. Although he knew what he had to do, he nevertheless wanted someone else to make the sole decision possible.... And so he spent long moments stubbornly dialing the telephone, and shouting into the telephone until hoarse: "Operator, this is an emergency...."

Soon after, the cable had to be cut anyway, but it would no longer descend into the bore hole. Too much time had been taken making the decision: The pressure of the flow had now attained tremendous proportions. In a few tense moments the cable and the perforating tool would be ejected out of the well. Soon the genie was to show himself as well....

The oilmen, immobilized by their own helplessness upon this lonely 30 by 30 meter platform 40 kilometers out to sea, watched the gusher as it began doing whatever it pleased. The odor of gas and petroleum grew strong--the danger of a gas explosion hovered menacingly. Al'nazim Guliyev gave an order to evacuate the maintenance personnel. Before leaving, workers of the geophysical party managed to carry a box containing 310 charges and 29 detonators away from the well, and disarm the perforating tool that was ready for the next descent. We need hardly explain the important role this played later on--the charges could have blown the platform to smithereens and ruptured all the pipelines--in a word, done a great deal of damage.

The people had barely managed to reach shelter when the night sky lit up with the glow of the explosion. Soon the 53-meter derrick shuddered heavily, and paint on the walls of the shelter several dozen meters from the fire began to blister. The flames illuminated with terrifying brightness to drillers that had been cast by the blast wave from a height of 14 meters into the sea. A patrol boat hastened to their rescue. Water jets from the monitors of the fireboat General Zeynalov flooded the people profusely, protecting them from the flames and heat. Their fate was literally decided in seconds.

The people were rescued. No one suffered.

Later a commission appointed by the USSR Ministry of Gas Industry, which has examined the causes of the disaster, will establish serious violations in the preparations and conduct of the perforating operation. Those to blame have been punished strictly. Such negligence and indecisiveness of some individuals led to a highly complex mishap. Now, others had to risk their lives to correct the aftermath.

Colonel Aleksandr Sorokin's telephone rang that night in his apartment. By force of habit Sorokin, deputy chief of the Azerbaijan SSR Ministry of Internal Affairs Fire Safety Administration, looked at his watch: It was 2135 hours. It was at this time that he received his first report of the fire at Bakhar.

At two in the morning the telephone ringing in the Moscow apartment of Rasim Tugushev, chief process engineer of the drilling section of Glavmorneftegaz [not further identified], returned him from the world of dreams into the stern reality of his official responsibilities. In the morning this famous gusher quenching specialist left for Baku on the first Aeroflot flight.

Towering above the sea, the flames seemed to boast of their gigantic proportions, and their power. The fiery genie laughed loudly above the people that set him free--this was the terrifying roar of the bestirred bowels of the earth.

There was no reaching No 73. And just a dozen meters from it operating well No 58 was continuing on with its honest day's work. It also faced impending disaster. It could burst from overheating at any minute. Then the situation could reach its worst.

The gusher control staff formulated its first task: protect No 58. A wall of water was to be created with powerful streams from the monitors so as to screen off No 58 from the raging fire; then the troubleshooters were to be landed together with their equipment on the platform, where they were to attempt to shut it off.

Colonel A. Sorokin and Z. Gurbanov, commander of the troubleshooters standing beside him on the deck of the fireboat General Zeynalov, smoked one cigarette after another and pondered what they could do with this mindless giant. Both knew quite well that it would be extremely difficult to shut off No 58, and that each step taken by a person setting foot on the burning platform could be his last. And they, the commanders, were the ones who had to tell their men to take this ultimately risky step. Unable to reach agreement as to which one was to stay, both began making themselves ready. They both wanted to go with their warriors in this first assault on the inferno.

A formidable torrent of water created by all of the fireboats together deflected the gigantic torch away. Installing compressors on the platform, the troubleshooters managed to pump a batch of slurry into well No 58 and "put it out of the game." Now it was time to fight the main enemy--well No 73.

It took half a day to prepare the assault party for its landing. Knowing quite clearly what was in store for them, troubleshooters Zakir Gurbanov, Saknib Dzhavadov, Viktor Dozdoy, Viktor Mayor, Gennadiy Zemtsov, and Karapet Martirosyan meticulously worked out their plan of operation.

The conditions were extreme to their utmost: The temperature of the torch was so high that a tree 50 meters away would burst into flames like a match. SCUBA apparatus and protective suits offered some defense against gas poisoning and the heat, but they made it very hard to move around, and to work in conditions where, balancing themselves as on a tightrope, the troubleshooters had to stand on pipe fragments above the raging sea, with partially scorched metallic structures sticking out of the water like spears.

The best gusher control specialists from other petroleum and gas regions of the country hastened to the aid of the Baku troubleshooters. Yu. Sorokin, M. Borodin, and V. Pevtsov came from Orenburg, D. Rymchuk and V. Chagovets came from the Ukraine, and A. Kulikov and V. Rezin'kov came from Krasnodar. They assumed their difficult, dangerous work hand in hand with Baku troubleshooters N. Dzhafarov, Z. Gadzhimuradov, and V. Demin.

The operations were supervised by Deputy Minister of Gas Industry T. Vekilov. He was assisted at headquarters by ministry specialists O. Blokhin and R. Tugushev, and M. Gamidov, chief of the Azerbaijan SSR Ministry of Internal Affairs Fire Safety Administration.

People countered the blind fury of the gusher with reason and calculation. But the weather kept getting in the way--sometimes the storm attained an intensity of 12 points. It was impossible to approach the burning platform. Waves pushed the ships toward the protruding piles of the wrecked platform, and standing at anchor was not without danger--there were petroleum and gas pipelines on the bottom, and they could be damaged by the anchors.

Such huge burning gushers are usually quenched by special devices. Water was able to put this one out. But it caught fire again immediately. And so it went on through several attempts. Its unexpected ignitions accompanied by explosions were extremely dangerous--after all, people were working at the well head within a gas cloud. This would be like performing gas welding in a powder magazine. In the end, the riddle was solved. The problem lay with paraffin issuing forth from the well. Paraffin is a dielectric.

And gas played the role of the "amber stick"--the accumulator of static electricity. One spark was enough to ignite the uncontrollable well.

The main torch was soon joined by a lateral one. It emanated from a crack in a burnt valve, and it made it extremely difficult to approach the well head.

This lateral flame had to be eliminated. It was then that they came up with the idea of using a tank. Soon the floating crane "Ker-ogly" placed a combat vehicle on the platform. Two shots tore off the useless valve and Christmas tree outlet. Now the gusher was purely vertical. On the next day the troubleshooters broke their way to the very well head, and under the cover of streams of water they removed the gas-damaged Christmas tree.

Now the highly critical operation of installing a strait jacket--flow control hardware--was to begin. Specialists hastening from the Turkmen and Uzbek SSR were to take part in it as well.

Here is an excerpt from the dispatcher's log: "There is no end to the work. We have been laboring 3 days at the well head, trying to install the flow control hardware. There is a 10-15 centimeter layer of paraffin covering the ships. It is impossible to walk or to use the mooring rope."

Chief Process Engineer Rasim Tugushev realized that if they were to act with dead certainty and without mistakes, he would have to carefully examine all of the "ulcers" on the outside of the valve. Several times during the day he landed on the platform and disappeared in the gas cloud, which could explode at any moment.

The moment for the operation had come. The floating crane held the equipment suspended over the work area, and Rasim Tugushev guided it, working at the very well head of the raging gusher. The pins holding the flow control hardware together were hard to set into place in the dense gas cloud. Totally exhausted, Rasim laid his body over the resisting valve, hoping in this way to push it into place. And at that very moment he was thrown from the platform by a colossal upsurge of gas. Who knows what his flight might have ended with, had it not been for the steel safety cables in which his arm got caught. R. Tugushev hovered between the sea and the gusher, above the spearpoints of the scorched pipes protruding upward far below. Regaining consciousness, he managed to free his stuck arm. Then he scrambled over the cable to the other side of the platform away from the abyss. When Rasim Tugushev emerged from the gas cloud, everyone aboard the ship gasped. He did not have his protective clothing on. The gas jet was so forceful that it blew the heavy troubleshooter's armor off in a fraction of a second. Throwing a poncho over his shoulders, he disappeared into the gas cloud once again. There was not a minute to lose in such a situation. The operation had to be finished. And this is what he did.

On 26 December 1979 the gusher was shut down. But by evening the pressure in the manifolds increased threateningly. The genie had to be freed once again.

Finally the beast gave way to the courage and knowledge of people. It submitted to them, and it became controllable. Moreover, as was reported from the Ministry of Gas Industry, the well will be put into normal operation in March.

Glavmorneftegaz drilling section Chief Processing Engineer R. Tugushev, who was directly in charge of the operations at the well head, said:

"The people displayed courage and high professionalism while placing the gusher under control. Thus they managed to force pipes down into the well under pressure with the help of hydraulics. Never before has a damaged well head been replaced on a gusher at sea. People did what appeared to have been impossible--they put the well back into operation. I would like to emphasize once again that this was the first time such a formidable gusher was placed under control in such a short time, and what is very important, without polluting the environment."

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FUELS

INADEQUATE SUPPLIES OF PIPE CASING REPORTED

Moscow NEFTYANIK in Russian No 2, Feb 80 pp 10-13

[Article by A. Kononykhin, Ministry of the Petroleum Industry and N. Bageyeva, VNIIOENG (All-Union Scientific Research Institute for the Organization, Administration and Economics of the Petroleum and Gas Industry): "What One Millimeter Costs"]

> [Text] Drilling organizations of the Ministry of the Petroleum Industry have been compelled to use thousands of tons of metal on reinforcing boreholes without reimbursement, because they do not receive enough pipe casing with thin wall diameters.

Scientific research institutes and NIS [scientific research stations] of associations make use of data from technical plans for the construction of boreholes which have been developed by planning institutes, when they are developing plans for norms of pipe-casing expenditures for the planning year in operational, surveying and exploratory drilling. In these cases the amount of pipe casing for a borehole or for a group of boreholes is decided according to diameters, wall thicknesses and strength groups. Of course, it is understood that in developing a plan for reinforcement of a borehole or a group of boreholes, one must, above all, assure adequate strength of the casing column. Simultaneously, one tries to make the casing column as light as possible, because this facilitates lowering it into a borehole, reduces metal consumption, transport expenditures, etc., and, in the final analysis, it decreases the cost of constructing a borehole. Consequently, a plan callsfor pipe casing with the thinnest possible walls selected from the State Standard recommendations. Obviously such an approach is up to date, economical and uniquely correct.

With this in mind and guided by the temporary situation of the organization of steel pipe supply by theoretical volume, which was established by USSR Gossnab in 1977 and by USSR Ministry of Ferrous Metallurgy in 1978, territorial scientific research institute and NIS of associations are developing norms for the consumption of pipe casing for industrial associations (in kg/m of passage). The demand for pipe casing for each association and for the industry as a whole is being determined on the basis of these norms. It would seem that everything is going well. No, not everything. Industrial associations exceed the established norms for consumption of pipe casing by different degrees from year to year, especially in operational drilling, for example, there is a clear lack of conformity for the planned norm of consumption with the actual specific consumption of casing. This lack of conformity is felt particularly in associations of Glavtyumenneftegaz [Main Administration of Tyumen' Petroleum and Gas], and also "Tomskneft'," "Tatneft," "Bashneft'," "Permneft," "Kuybyshefneft'," and "Orenburgneft'," (Table 1).

Even a small error in determining norms of consumption of pipe casing substantially effects the calculated demand for pipe casing for the year being planned, when there are large numbers of drilling operations involved. Actually, reducing the norm for consumption of pipe casing in operational drilling by Glavtyumenneftegaz by only 1 kg/m can lead to a deficit of 7,400 tons, and this means that about 70 boreholes will not be able to begin operation. Consequently, one of the essential factors in developing pipe casing consumption norms for associations and the industry as a whole is the sequence of determining the theoretical (surrendered) mass of 1 m of pipe casing, which are produced by pipe rolling plants of the USSR Ministry of Ferrous Metallurgy.

According to the temporary situation of the organization of steel pipe supply based on theoretical volume which was mentioned above it follows that the theoretical (surrendered) mass of 1 m pipe casing should be determined for each nominal section of pipe by multiplying the mass of 1 m of pipe (according to GOST632-64) by the length of a pipe, plus 4 percent of the pipe mass, plus the mass of a single sleeve of corresponding diameter (according to GOST632-64) and dividing this sum by the length of the pipe. A mass greater than 4 percent should not be considered, and yet the registration of pipe casings must be considered in the expenditures, being guided by the same temporary situation regarding the organization of steel pipe deliveries based on the theoretical mass with consideration of the mass of sleeves, based on certificates of manufacturing plants. Minneftprom, together with VNIITneft' [All-Union Scientific Research Institute for Development and Operation of Petroleum Industry Piping], must introduce the appropriate changes in the established method for calculating norms of pipe casing expenditures in the stage of determining the mass of 1 m of pipe considering the planned additional allowance, equal to 4 percent, and the sleeve mass. Until now the territorial scientific research institutes and NIS of associations, in developing norms for pipe casing consumption (including for 1980) have taken the mass of 1 m of pipe according to the methodology of VNITTneft' with consideration of the planned allowances, plus 5 percent for all pipe rolling plants, and plus 7 percent for Chelyabinsk Pipe Rolling Plant.

Is this adjustment essential? As an example we can point out that a request for pipe casing of the group of strength "D" alone by Glavtyumenneftegez is about 300,000 tons. One percent then is a loss of over 3,000 tons of pipe casing, and this means that approximately 30 boreholes will not be supplied. For the industry as a whole these figures are substantially higher.

This is one of the reasons for the lack of conformity of the plan in actual norms for the consumption of pipe casings. The second reason is that pipe-rolling plants of USSR Minchermet produce pipe casing in certain wall thicknesses in a limited number or do not make them at all (in an assortment envisaged by GOST-632-64). Such pipe casing includes pipes in the strength group "D" 140X7mm, 146X7mm, 168X7mm, 178X7mm, 194X7mm, 219X8mm, 245X8mm, 299X9mm, 324X9mm, 426X10mm, whose demand is great. Note the fact that these are pipes with the thinnest wall in each of the diameters, thus they are the lightest and the most economical ones. In place of thin-wall pipe casings, pipe rolling plants supply Minnefteprom with thicker-wall pipes. The difference is seemingly not very great--1 mm, but this leads to a significant excess consumption of metal, an increase in transport expenditures and increased costs of borehole construction.

Thus, in 1979 industrial associations of Glavtyumenneftegaz ordered 9,145,200 m of pipe casing in strength "D," whose total mass was 305,700 tons but 9,091,300 meters were delivered with an overall mass of 316,800 tons (Table 2). As we see, this was a shortfall of 53,900 m of pipe casing, but the weight "overfulfillment" was 11,100 tons. Such an "overfulfillment" is very expensive. There was not enough metal for reinforcing more than 20 boreholes and there was an irreversible loss of a large amount of expensive metal, which would have been enough for manufacturing pipes for reinforcing about 110 boreholes. Moreover, the cost of the actual delivery exceeded the planned delivery by more than 2.5 million rubles (without expenditures for transports of large-mass pipes).

Calculations suggest three dimensions of pipe casings in strength group "D"--146X7mm, 168X7mm and 235X8mm--according to Minnefteprom a significant amount of metal, which is so necessary for the national economy (Table 3) was overexpended in 1979 due to delivery to drilling organizations, which work in the eastern regions, of pipes with wall thickness not of 7 - 8mm, but of 8 - 9mm. The forced replacement of pipe casings by thicker-walled ones leads to a significant decrease in their volume--more than 800,000 m. This means that more than 350 boreholes cannot be cased (under conditions at Glavtyumenneftegaz). Such is the price of a single millimeter.

These figures are convincing evidence that the petroleum industry and the entire national economy are experiencing substantial losses due to underfulfillment of pipe casings with wall thicknesses of 7 and 8 mm. It is not our purpose here to explain all of the technical, technological, organizational and other causes, due to which pipe rolling plants have not been able to satisfy the requests of Minnefteprom in recent years for thin-walled pipes (specialists of USSR Minchermet can and should do this), but one of them can and should be named. Much has been said and written about this cause, but it has to be repeated again and again. The fact is that planning the demand for pipe casing at Minnefteprom and planning their output at USSR Minchermet are done in different ways, which are not in conformity with one another and, on the contrary, are done in contradiction to the indices.

Table 1

Production Associations	Goal of Drilling	Established Consumption Norm, kg/m	Actual Specific Consumption, kg/m	Established Consumption Norm, kg/m	Actual Specific Consumption, kg/m	Established Consumption Norm, kg/m	Actual Specific Consumption, kg/m
Associations of Glavtyumenneftegaz	Exploratory	43.5	44.7	43.5	44.9	43.5	45.2
	Surveying	35.2	33.0	35.0	35.0	35.0	32.1
"Tomskneft'"	Exploratory	--	--	43.5	41.4	41.6	45.5
	Surveying	--	--	35.0	35.0	35.0	40.0
"Tatneft'"	Exploratory	42.0	42.2	42.0	42.2	42.0	42.6
	Surveying	31.0	41.1	35.0	40.0	34.2	39.4
"Dashneft"	Exploratory	40.0	40.7	40.0	41.0	41.6	40.7
	Surveying	27.0	30.0	30.0	38.0	38.0	38.0
"Kuybyshevneft'"	Exploratory	46.0	48.5	46.0	46.1	46.0	45.7
	Surveying	29.0	29.6	30.0	26.3	29.3	25.2
"Permneft'"	Exploratory	41.5	43.0	41.5	45.4	41.5	43.5
	Surveying	34.0	27.2	31.0	29.3	28.0	27.1
"Mangyshlakneft'"	Exploratory	44.0	44.0	44.0	45.7	46.4	48.5
	Surveying	65.0	62.9	66.6	67.4	66.6	67.7
"Orenburgneft'"	Exploratory	53.0	58.0	53.0	60.2	56.0	59.4
	Surveying	43.0	47.5	43.0	52.8	46.5	41.9

Table 2

Indices	Diameters and Wall Thicknesses of Pipes, mm								
	146X7	146X8	168X7	168X8	245X8	245X9	324X10	426X11	Altogether
Mass of 1 m of pipe, kg	26.0	29.4	30.1	34.1	50.5	56.7	83.8	124.2	
Piping ordered,									
thousands of m	4,128.5	1,171.4	1,340.9	543.7	1,827.3	—	93.8	39.6	9,145.2
thousands of t	107.3	34.4	40.4	18.6	92.2	—	7.9	4.9	305.7
Piping produced,									
thousands of m	2,915.4	2,169.4	920.3	1,136.1	790.5	1,030.7	89.3	39.6	9,091.3
thousands of t	75.8	63.8	27.7	38.8	39.9	58.4	7.5	4.9	316.8
Deviation from order,									
thousands of m	-1,213.1	+ 998.0	-420.6	+592.4	-1,036.8	+1,030.7	-4.5	—	
thousands of t	- 31.5	+ 29.4	- 12.7	+ 20.2	- 52.4	+ 58.4	-0.4	—	
Shortfall (over-supply) of pipes by diameters,									
thousands of m	-215.1		+171.8		+6.4		-4.5	—	-53.9
thousands of t	- 2.2		+ 7.5		+6.0		-0.4	—	+11.1

Table 3

Indices	Diameters and Wall Thicknesses of Pipes, mm						
	146X7	146X8	168x7	168X8	245X8	245X9	Altogether
Piping ordered,							
thousands of m	9,380.8	--	1,982.7	--	2,975.8	--	14,339.3
thousands of t	243.9	--	59.7	--	150.3	--	453.9
Piping produced,							
thousands of m	4,775.4		1,451.8		849.1		7,076.3
thousands of t	124.2		43.7		42.9		210.8
Deviation from order,							
thousands of m	-4,605.4		- 530.9		-2,126.7		-7,263.1
thousands of t	- 119.7		- 16.0		- 107.4		- 243.1
Replacement of pipes (according to mass) by pipes of the same diameter, but with a thicker wall,							
thousands of m		4,072.8		468.6		1,894.2	6,435.6
thousands of t		11,967		16.0		107.4	243.1
Shortfall of piping as a result of replacement,							
thousands of m	532.6		62.3		232.5		827.3

For Soviet drillers the plant assignments are given in meters of borehole depth, for which quiet specific lengths of pipe casings are required, but later these meters are converted into tons, insofar as the plan for pipe rolling plants is given in tons. Then the pipes are shipped to the customer--Minnefteprom--in tons.

Given such a method of planning, plants of USSR Minchermet, as is evident, are not interested in increasing the production of more economical thin-wall pipe casings. It is obviously much simpler to fulfill the plan with thick-wall casings, which moreover have greater tolerances. But the entire national economy of the country bears losses, unjustifiably spending many thousands of tons of metal in the drilling of boreholes. Examination of the plans for consumption norms of pipe casings for associations of Minnefteprom, which are coordinated with the main institute for development of the basic material resources for drilling by V1NNIOENG, indicates that for even 1980 the territorial scientific research institutes and NIS of associations selected thick walls in calculating the consumption norms for pipe casings, as they did earlier, separately from their actual production by industry. Consequently, even in the last year of the Tenth Five-Year Plan and evidently, even in subsequent years the petroleum industry will experience serious difficulties in realizing the drilling program of operational, test and structural-exploratory boreholes.

In this connection there is an opinion, which the authors of this article share that VNIITneft', VNIIOTENG, territorial scientific research institutes, and NIS of associations must develop and introduce the necessary corrections both in the methodology for determining pipe casing consumption norms as well as in the plans for their consumption norms in the eastern oil regions within 1980, in order to provide pipe casing for all of the planned drilling. This methodology should take into account the actual increase in consumption (by mass) of pipe casing due to enforced increase of wall thicknesses as opposed to those envisioned in plans for the construction of oil and gas wells in each association in the past 3 years.

The next step in improving the methodology for developing pipe casing consumption norms should be determination of advanced consumption founded standard demand for pipe casing in tons according to diameters, wall thicknesses and strength groups for production associations and for the industry as a whole. But the pipe rolling plants of USSR Minchermet must reorganize their organization in such a way as to completely satisfy the demand of the national economy for pipe casing in conformity with a standard demand.

Speaking at the November (1979) Plenum of CPSU Central Committee, General Secretary and Chairman of the Presidium of the USSR Supreme Council Comrade L. I. Brezhnev noted that, inspite of the huge scale of metal production, it is not abundant as it formerly was, and that machine builders require great amounts of it because the metal consumption of many machines and much equipment being produced remains immoderately high. This point is especially true of the production of pipe casing. A great deal of it is being produced by tube rolling plants, but, as before, the metal consumption is unjustifiably high both due to the limited output of thin-wall pipes and also due to rolling of pipes with large positive tolerances. The time has come for tube rolling plants and the main institute of VNIITI of USSR Minchermet to immediately develop and adopt organizational and engineering procedures to increase the production of pipe casing with minimum wall thicknesses and for the further reduction of the theoretical mass of 1 m of piping by making tubes with minus tolerances.

At the November (1979) Plenum of the CPSU Central Committee Comrade L. I. Brezhnev mentioned the "...continued economical method of operating, rational utilization of material and financial resource..." among the main guidelines for organizational, popular-political and ideological work. Reorganization of the planning system for production of pipe casing and reducing metal consumption in borehole construction are entirely within this requirement.

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WELL MANOMETER MGN-5: DEVELOPMENT AND OPERATING CHARACTERISTICS

Moscow NEFTYANIK in Russian No 2, Feb 80 pp 14-15, 22

[Article by A. Petrov, VNIIKANeftegaz (All-Union Scientific Research Planning and Design Institute of Complex Automation in the Petroleum and Gas Industry)]

> [Text] It is possible to use the highly precise, unitized manometer MGN-5 for measuring pressure in wells under various geological and engineering conditions in place of several depth devices. It can be used alone or in conjunction with logging stations.

Self-contained and remote manometers for studying oil and gas wells currently being produced differ from one another not only in their technical features. Each of the devices, as a rule, is an original article, which does not have standardized parts and connections. This makes organization of their serial production quite different and complicates their operation.

In trying to create a standardized system of devices for investigating wells, institutes of VNIIKANeftegaz and VNII [All-Union Scientific Research Institute of Petroleum and Gas] developed an aggregate complex of depth devices (NEFTYANIK, No 11, 1974). The devices included in this set are constructed according to the block principle and can be assembled either in the form of self-contained devices, which are lowered on a wire, or in the form of remote transformers, which are lowered on a geophysical cable.

The depth manometer of the aggregate set "Baykal-2" is a device consisting of the measuring unit, with a recording apparatus and a power supply, which assure recording of readings on graph paper and also a remote accessory with a pulse convertor, which assures transmissions of readings along the cable to the surface. The manometer differs from existing devices, above all, by the fact that one and the same measuring unit, which is easily connected to the recording device or the remote accessory by the aid of a spring clamp, is used for self-contained and remote operations. In this manner, in place of two devices which are different in design there is one which, depending on the investigation assignment, can be lowered into a well on a wire or a cable.

In its technical characteristics the manometer "Baykal-2" is not inferior to the best kinds of Soviet and foreign devices with the same purpose. In particular, the error rate of the manometer in self-contained and remote operation is 0.25-0.6 percent. By comparison the error rate of the remote manometer MGD-36 is 2 percent, and that of the manometer of the apparatus "Potok-5" is 1.5 percent. The pressure recording length in self-contained operation is 200 mm (in the helix manometers MGN-2 it is 50 mm, and in the spring-piston manometers it is 100 mm).

However, the manometer "Baykal-2" was not put into serial production mainly because of the fact that for remote operation it was necessary to also produce a new, secondary device--reversing pulse counter. Moreover, the stations APEL, AIST which are used for investigating wells, are only provided with frequency meters.

Therefore, in 1978, the institute VNIIKANeftegaz, using the manometer "Baykal-2," developed a new design, the manometer MGN-5 with a frequency output signal.

The operating principle of the manometer MGN-5 is based on power compensation. The measured pressure P_{well} (Fig. 1), acting on sensitive element 1, is converted into force R, which is automatically equalized by force $R_{feedback}$, which is developed by the feedback power mechanism. If there is an inequality of these forces an electric current I goes through the contact O-element 2. This electric current feeds electric motor 3, whose shaft is kinematically connected to compensation spring 5 and element 4 which converts the shaft revolution angle φ into an output signal, a mechanical displacement of L.

When using the manometer as a self-contained device, mechanical displacement of the recording pen is registered on the graph paper form, which is inserted on a drum of clock mechanism 6. The electric motor is powered by a battery of dry element 7, which are installed in the self-contained power supply unit. In the remote device, during mechanical displacement of the core, generator frequency f changes. The electric motor power supply comes from a ground source along a single-strand cable, and the electrical output signal is transmitted along this same cable to the frequency meter.

A three-positional relay, which consists of two immovable 2' and 3' and single movable contact K, which is rigidly connected to the sensitive element, the helix spring, is used as a null-balance device. Reversing of the electric motor during an increase or decrease of pressure is accomplished by the aid of two relays, which are included in the standardized unit for controlling the electric motor operation.

During an increase of the measured pressure the contacts K and 2' of the null-balancing element close and power is sent to the windings of relay P1. After triggering of the relay the power is supplied to motor M through the close contacts 1-3 of relay P1. The motor deforms the compensation spring 5 until the spring tension force is no longer equal to the force developed by sensitive element acted upon by the measured pressure. At this time the contacts of the null-balancing device open up, and the motor stops. Simultaneously, the P1 relay contacts are disconnected.

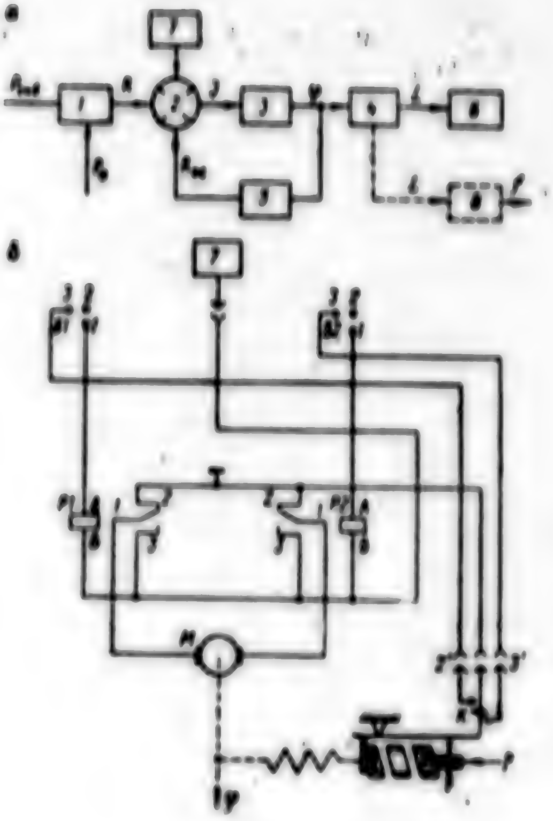

Fig. 1. Structural (a) and main (b) Circuits of the Manometer Device MGN-5

Key:

1. P_{well}
2. $R_{feedback}$

During a decrease in pressure magnitude the contacts K and 3' of the null-balancing device close, relay P2 is actuated, and power to the motor is fed through the closed contacts 1-3 of relay P2. In view of the change in the polarity of the voltage which is supplied to the electric motor, it begins to rotate to the opposite side. At this time the tension force of spring 5 decreases to equality with the force which is developed by sensitive element 1. In equilibrium position the contacts of the null-balancing device open, and the motor stops.

In this manner, depending on whether the measured pressure decreases or increases, the shaft of motor M will rotate in one direction or the other. The micro switches B1 and B2 are used to interrupt the power supply circuit in case the magnitude of the measured pressure becomes greater or lesser respectively than the upper or lower measuring limits of the devices.

In structure the manometer MGN-5 (Fig. 2) consists of a measuring transducer I, recording device II with self-contained power supply block III and remote accessory IV.

The measuring transducer of the manometer, in turn, consists of an electric motor unit and a sensitive element unit, which are easily connected by a spring clamp.

The measured pressure through bellows 10 is transmitted by a fluid, which fills the cavity of helical spring 9, which carries out the function of a separator. The free end of the helical spring is rigidly connected to a screw compensation spring 7, which operates torsionally, and by movable contact 8, which is located between immovable contacts.

During a change in pressure the free end of helical spring together with contact 8 revolves and closes the power supply circuit of the direct current electric motor 6, which twists the second end of compensation spring 7 through step-down reducer.

Rotation of the motor shaft continues until the moment, which is created during twisting of the compensation spring, does not balance the moment which is transmitted by helical spring, which is proportional to the magnitude of the measured pressure. In this case, the movable contact will rotate to a neutral position and will disconnect the power supply circuit of electric motor 6. The number of revolutions of the electric motor shaft will correspond to the angle of twist of compensation spring, and consequently, to the magnitude of the measured pressure.

In this manner, during measurements the free end of the helical spring is practically unaltered, because the distance between the movable and the immovable contacts is 0.1-0.15 mm. Therefore, the error rate of the device is determined only by the quality of the compensation spring and in practice does not depend on the elastic properties of the helical spring.

Using the compensation circuit for measuring permits one to simultaneously substantially decrease the length of the helical spring used to 100-150 mm (instead of 500-700 mm), and this significantly simplifies its manufacture.

Introducing a step-down reducer permits one to use a standardized electric motor unit, whose shaft completes 40 revolutions in twisting the compensation spring by 1.5 revolutions. Relays 18, which provide shaft reversing, and also an intermediate motion screw 17, on which nut 16 is moved, by pressing on the micro switch contacts 19 in extreme positions, are mounted in the electric motor unit.

The measuring transducer is connected to the recording device in the self-contained mode. In this case the electric motor shaft, by twisting the compensation spring, simultaneously rotates the motion screw 2, along which nut 5 with the recording pen 4 shifts forward. Recording the pressure change in time is accomplished on the graph paper form, which is inserted on drum 3 of the clock drive 1. The battery of dry elements or accumulators, which assures operation of the device for 10-15 triggerings without recharging, is installed in the self-contained power unit.

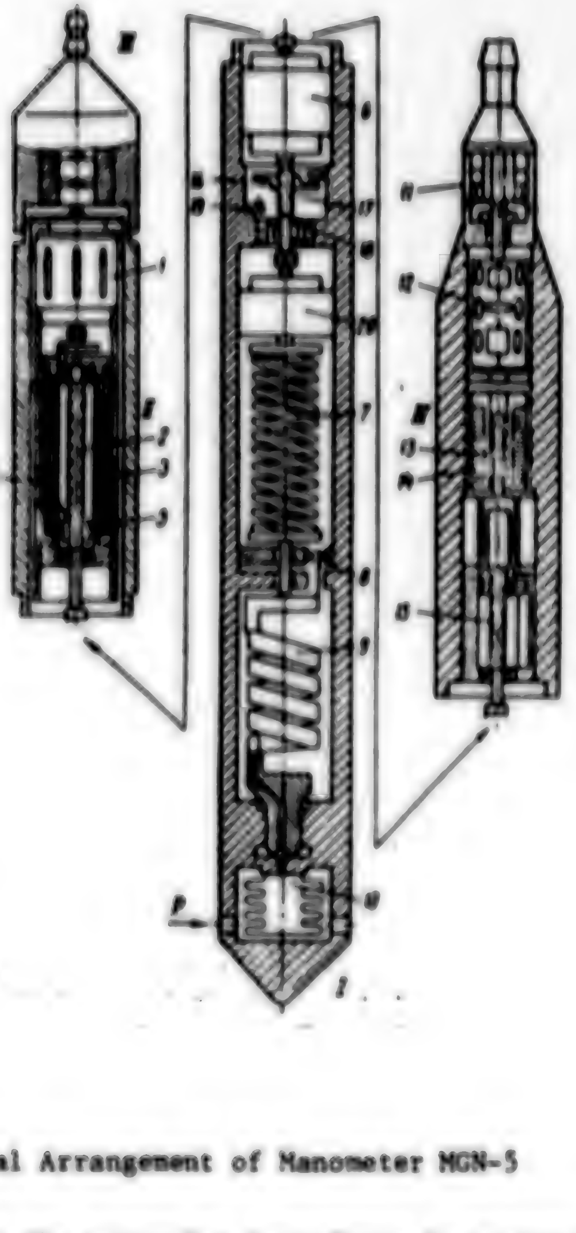

Fig. 2. Structural Arrangement of Manometer MGN-5

In the remote mode the measuring transducer is connected to a remote accessory. The electric motor shaft rotates motion screw 15, along which a ferrite core 13 shifts forward, which changes the inductance of coil 14 of generator 12.

In the remote version of manometer MGN-5 a generator circuit is used which was developed by VNII for the pressure counter of the "Potok-5" apparatus. A standardized head 11 is used to connect the device to a cable.

In comparison with the pulse convertor of the "Baykal-2" manometer the frequency convertor of the MGN-5 device has an additional error rate, which is related to the nonlinearity of its characteristics and by the relationship of the output signal to temperature. Therefore, the overall error rate of the remote manometer MGN-5 is 1-5 percent, and for the self-contained one it is 0.26-0.6 percent.

Technical Characteristics of the Manometer MGN-5

Upper measurement limits, kgf/cm^2	250 and 400
Working temperature range, °C	10-100
Frame diameter, mm	36
Length of the device, mm	
Self-contained (depending of power unit)	1,850-2,125
Remote	1,850

Thus, by using the manometer MGN-5 it is possible to conduct investigations of wells in the majority of oil and gas producing regions of the country. The possibility of lowering devices in self-contained mode--on a wire--or in the remote mode--on a cable--allows one to expand the area of their application to high production oil and gas wells. Technical maintenance of the manometer is substantially simplified in this case because of the use of standardized units and parts.

In 1978 test models of well manometers MGN-5 successfully passed state acceptance tests. Serial production of these manometers will be accomplished at the Ivano-Frankovskiy Instrument Construction Plant.

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WORK OF OSDB IN MAKING DRILL BITS

Moscow NEFTYANIK in Russian No 2, Feb 80 pp 16-18

[Article by F. Tsikunov, Bashkirskaya OSDB, V. Labutin, Association "Bashneft'," M. Abramson and M. Aleksandrob, VNIIBT: "The Effect of Centralization"]

> [Text] Improvement of the system of milling a rock-crushing drilling tool in order to assure its rational application and effective operation has been frequently examined in the periodical press (for example, see ORGANIZATSIYA I UPRAVLENIYE NEFTEDOBYVAYUSHCHEY PROMYSHLENNOSTI, No 11, 1970; EKONOMIKA NEFTEDOBYAYUSHCHEY PROMYSHLENNOSTI, No 1, 1971; KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE, No 11, 1974; NEFTYANIK, Nos 6, 7, 8, 1973, No 4, 1979). Different aspects of the efficiency and technical and economic effectiveness of the new system of milling drill bits have been examined in detail in these publications, along with their organizational forms, interconnections (including legal ones) between the manufacturers of the rock-crushing tools, bases (storehouses) and drill bit customers. The operating experience of the first specialized drill bit base, which serves drilling enterprises of the "Tatneft'" association was also examined.
>
> Today we offer this article on the work experience of the experimental specialized drill bit base (OSDB), which was created in the second half of 1974 to serve all drilling enterprises of "Bashneft'" association. It is located in Ufa and is subordinate to Verkhneserginskiy Drill Bit Plant of Minkhimmash [Ministry of Chemical and Petroleum Machine Building].

Before the creation of OSDB the supply of drilling organizations of "Bashneft'" association with rock-crushing tooling was done from several "drilling staging areas," which were located in various regions of Bashkiriya. Decentralization of supplies and irregularity of drill bit shipments in different sizes by the manufacturing plants led to a situation in which:

--drill bit stocks were dispersed among numerous sites which had practically no connection with one another, many of them did not have the required sets of drill bit sizes, a disproportion in the available selection of drill bits came about and continued to be the case, and large numbers of drill bits in a limited number of sizes accumulated;

--it became necessary to frequently transfer drill bits of unavailable sizes from one place to another with unjustifiably large transport use;

--very large stockpiles of drill bits accumulated at the staging areas, which were significantly greater than the volume of drilling operations called for for any given association;

--there was repeated handling of drill bits (manufacturing plant--railroad--UPPO and KO bases; transport--UBR [drilling operation administration] site--transport--drilling site), which led to mechanical damage of many drill bits (losses of caps which protect the threading and subsequent damage to the threading itself, destruction of the headpieces and their reinforcing and sealing elements, tooth brakes, particularly the hard alloy ones, etc.), which reduce their operating lives;

--mechanization of the loading and unloading operations grew slowly, the amount of manual and heavy labor being very great.

As a consequence of this situation there was an irrational utilization of drill bits and an extremely slow improvement in upgrading efficiency which could in no way satisfy the requirements for growth rates and quality of well drilling. It was expected that the majority of these shortcomings could be eliminated by changing the way in which drilling enterprises were supplied with rock-crushing tooling. The Bashkirskaya OSDB was created for this purpose, whose assignments included:

--determination (jointly with the engineering surfaces of an association, UBR, GPK of the demand for rock-crushing drilling tools based on nomenclature, grade and quantity, filling out applications for it, and obtaining the necessary funds for them;

--concentration of the drill bits received at the OSDB;

--provide for initial inspection of drill bit quality, return defective drill bits to the manufacturing plants;

--assembly of (in conformity with the established regulations for efficient handling of drill bits) sets of drill bits in the required sizes for each drilling operation and delivery of these sets in complete units directly to each drilling site, by-passing any intermediate transshipment points;

--monitor correctness of drill bit performance by analyzing the results of their operation, the nature of wear and causes for malfunctioning so that the regulations, applications and sets of drill bits can be adjusted accordingly;

--test batches of drill bits with new and improved designs in the tests.

Work of the OSDB began with consideration of the actual left-over drill bits at the facility and at UPTO and KO staging areas, at the UBR, GPK and at drilling sites. This work was carried out jointly with the engineering services of the association, UBR and GPK. It was discovered that above normal drill bit reserves, which accumulated in the preceding years, had reached 51,000 pieces by January 1975. But even so there was a sharp deficit of drill bits with hard alloy teeth. Almost 92,000 drill bits were ordered for 1975 while there was an actual consumption of about 53,000 items in 1974. This meant that by the beginning of 1976 the association "Bashneft'" had almost a 2-year supply of drill bits, but the trouble is that the particular make-up of this reserve did not meet the requirements for drill bit selection.

Thanks to the appropriate steps that were taken and, above all, to centralization of the system for supplying drill bits the reserves were lowered in 1977-1978 to 16,000-18,000 pieces which freed up about 5 million rubles of working capital.

The second priority in work of the Bashkirskaya OSDB from the very beginning of its creation was the study (jointly with the engineering services of the association, UBR and GPK) of the conditions and results of drill bit performance, which led to the development of standards for making drill bits in complete sets of their efficient models and with recommendations for drilling procedures for the majority of Bashkiriya staging areas, on the basis of which annual requests for drill bits are made.

In 1975, 416 drilling sites were provided with complete sets of efficient models of drill bits according to the established regulations, in 1976, 871 drilling sites were supplied, in 1977, 828 drilling sites were supplied and in 1978, 919 drilling sites were supplied. Moreover, in 1976, 1977 and 1978 replacement of sets of efficient models of drill bits for 65, 107 and 69 drilling sites respectively was carried out. Note that the production activity of OSDB is based on contractual agreements with the manufacturing plants on the one hand, and with drilling enterprises on the other hand. The schedule is made in the following manner: each UBR and GPK sends the OSDB an order for the complete needs of wells, whose drilling is planned for the next month, in sets of drill bit models, and also a report on the movement of drill bits for the preceding month. On this basis, and with consideration of earlier established regulations OSDB, sets of efficient drill bit models for digging each well are made up and their centralized delivery to drilling sites is organized by aid of special vehicles, which are equipped with hydraulic lifts.

The use of efficient drill bit types in conformity with properties of the rocks to be cut through allow the association "Bashneft'" to achieve an overall increase by the middle of 1979 for passage per drill bit in comparison with 1975 in operational drilling of 12.2 m (28.6 percent increase). and for exploratory drilling of 2.4 m (10.5 percent increase).

Thus a savings in operating expenditures was achieved: 679,700 rubles in 1976, 529,400 rubles in 1977 and 737,700 rubles in 1978. Overall the association "Bashneft'" obtained a reduction in drill bit consumption from 56,600 pieces in 1975 to 45,300 pieces in 1978, for a reduction of 25 percent, and the presence at the OSDB of a centralized, irreducible reserve of the necessary sizes of drill bits in the amount of 16,000-18,000 pieces per year assures the uninterrupted operation of all drilling brigades of the association.

It should be emphasized that the opportunities for increasing passage per drill bit by using efficient sets of drill bit models are far from having been exhausted.

Another important priority in OSDB is conducting operational tests of new designs of drill bits, monitored operation of improved drill bit designs and sinking test wells (there were 12 of them drilled in 1978 alone), which were outfitted with different sets of drill bit models. And the results of these tests and tests conducted jointly with VNIIBT, SKBD, PO, "Kuybyshevburmash" and with the engineering services of the association and UBR, we discovered a high degree of efficiency in specific groups of rocks for drill bits in the new series GNU, in models MZ, SZ, TZ, TKZ in the rotary drilling method and in combination with helical motors and with reducing gear electric drills, and for drills of the type CZ-GV in turbine drilling.

Even limited application of these drill bits in the composition of the sets of drill bit models used has already brought about increase in passage per drill bit of Ø 215.9 mm of 15.4 m on the average, and for the drill bit Ø 190.5 mm of 5.8 m on the average (in operational and prospecting drilling together). Completed operations show that the widespread introduction of drill bits in series GVNU in Bashkiriya permits a 1.5-2-fold increase in passage per drill bit by comparison with what has been the case before. However, to accomplish this much work is needed to improve the engineering discipline in drilling and better organization of bits monitoring. In solving this problem the engineering services of the association and UBR, and also OSDB need scientific method logical help from VNIIBT and its Oktyabr'skiy department, and from the institute BashNITIneft' and UNI [Ufa Petroleum Institute].

OSDB pays much attention to initial inspection of the quality of drill bits supplied to them. Thus, in 1978 using a method developed by VNIIBT using a KP-2 device they checked 6,271 drill bits, of which 246 were broken. The work done was immense but this was inadequate even so. Actually, almost 12 percent of the incoming drill bits were inspected and 3.9 percent of this number were broken. If this percentage is true of the total number of entering drill bits which evidently is the case, then about 2,000 drill bits which are sent to the drilling site arrive with undetected defects. This, of course, cannot fail to lower the efficiency of drill bits overall for the association. Consequently, initial inspection requires greater efforts in order that not even one defective drill bit arrive at a drill site.

Let us now note another aspect of the work of the colleagues at OSDB. Together with the engineering services of the association and UBR, they carried out checks of a gamut of drill bits at the Ishimbayskiy, Neftekamskiy and certain other UBR, in which they discovered instances of insufficient deliveries of drill bit sets, poorly made drill bits with hard alloy reinforcements, and also use of the wrong kinds of drill bits for the rocks being crushed.

There are a number of other difficulties in the production management work of the Bashkirskaya OSDB. First of all, there is the lack of warehouses. Drill bits are stored on scaffolding in the open air and, naturally, they are subjected to the influence of atmospheric precipitation, which frequently leads to metal corrosion, loss of lubricant and a reduction in their operational features. The lack of approach railway lines (directly to OSDB) causes many additional troubles. The drill bits must be handled twice, which leads to an increase in labor and material expenditures. Another shortcoming is the fact that the delivery of drill bits to certain drilling sites is still done through intermediate UBR staging areas, which results in incomplete sets of drill bits and reduces their safety.

Thus, in Bashkiriya on a scale of an association with a large number of drilling operations, about 2 million m per year, there is an accumulated experience of providing drilling sites in the sets of efficient models of drill bits in conformity with the properties of the rocks being bored through in a centralized order by means of OSDB. This yields a significant technical and economic result (more than 2 million rubles). The effectiveness of introducing this new advanced system of milling and efficient utilization of drill bits is again confirmed. This experience should be achieved by all associations conducting drilling operations.

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FUELS

SCIENTIFIC AND TECHNICAL PROCESS, PLANNING IN THE OIL INDUSTRY

Moscow NEFTYANIK in Russian No 2, Feb 80 pp 38-41

[Article by M. Sattarov, doctor of technical sciences, professor, VNIIOENG [All-Union Scientific Research Institute for Organizing the Management and Economics of the Petroleum and Gas Industry]

[Text] A distinguishing feature of the modern era is the accelerated growth of science and technology and the growth of their effect on all spheres of human activity. The role of scientific and technical progress in the development of productive forces is rapidly increasing, and science itself has transformed into a direct productive force of society. Modern production is already not able to function normally, which will increase as it develops successfully, without depending directly on the recommendation of science, its assumptions and conclusions.

The need to accelerate scientific and technical process and to connect science with production was mentioned repeatedly in resolutions of the 24th and 25th CPSU Congresses. In a summary report of the Central Committee to the 24th CPSU Congress the General Secretary of the CPSU Central Committee, Comrade L. I. Brezhnev noted that the decisive acceleration of scientific and technical progress remains one of the main tasks, that it is not separate achievements of science which are important, however brilliant they are, but a high scientific and technical level of overall production, which stands before the Soviet people as a task to organically unite the achievements of the scientific and technical revolution with the advantages of the socialist system of society, and to widely expand the forms of the connection of science with production which are inherent in socialism. The problem of accelerating the rates of scientific and technical progress as a decisive condition for improving the efficiency of social production and of improved production quality stands as one of the most important problems in the resolutions of the 24th CPSU Congress.

These instructions of the party in government have always been at the center of attention for petroleum workers. The introduction of achievements of science and technology in all branches of petroleum production technology have played a decisive role in assuring high rates of growth for petroleum industry, along with the discovery and accelerated introduction of new high production deposits into operation. One of the basic achievements of the petroleum industry of our country is the widespread introduction of methods of maintaining plastic pressure (PPD), which in the USSR in contrast to other petroleum-producing countries, are used from the very onset of exploitation of the deposits and are executed in the form of external and internal flooding. The transition to a relatively sparse network of operating wells has been affected simultaneously to the use of PPD methods. Maintaining plastic pressure assures high well yields and the use of a sparse network, when a single well has large reserves, creates conditions for its prolonged and stable exploitation.

Using the methods of flooding in a test over many years showed that they are not universal, identically effective in different geological and physical conditions. Thus, in the case where highly viscous oil is contained in a bed, ordinary methods of flooding bring about a quick entry of waters into the operating wells, which means that exploitation of a deposit is accompanied by recovery of large amounts of accompanying water, and the final oil yield is decreased. Under conditions of complexly constructed discontinuous and lens-shaped collectors, methods of flooding lose their main advantage--the possibilities of using sparse networks of wells. In beds with low permeability, ordinary water incompletely displaces oil from the porous medium. After considering these factors, the Ministry of the Petroleum Industry and its scientific research institutes are conducting an important project for selecting new methods of working beds. At the present time commercial tests involving different versions of thermal action, pumping in water treated by chemical reagents, a water and gas mixture, a high pressure gas, etc., are being conducted.

The wide introduction of the achievements of scientific and technical progress is also going on in other branches in the petroleum industry. For the past 10-12 years a technical reequipping of petroleum-producing regions has been going on, on a basis of overall automation. In the area of oil production and commercial construction, a standardized technology for hermetic sealing of oil deposits has been developed, whose technical base comprises completely unitized and automated equipment. The new technology has led to a radical change in a system for servicing commercial facilities and puts commercial construction on an industrial basis. Modern technical solutions have changed the nature and the very content of commercial construction--expensive construction projects, which are conducted directly at the plant sites (frequently with no roads at all, no living quarters or industrial facilities)--were replaced by industrial methods of assembling unitized equipment manufactured at the plant.

An important project for technical reequipping drilling enterprises, for improving work organization and administration of them, and improving drilling technology was conducted in order to increase production efficiency.

Production efficiency increased significantly in the area of oil transport. Large capital, material and technical resources were allotted for the construction to main oil pipelines. Giant oil pipelines were started up for transporting oil from new gas and oil bearing regions, and powerful propane stations were built, during whose construction unitized automated equipment was widely used.

Much attention has been devoted to developing the gas refining industry. In recent years the growth in the volume of capital outlays for construction of gas refining plants has led to a significant reduction in the loss of casing-head gas.

The accumulated experience and also the new scientific and technical solutions have made it possible to put the Western Siberian deposits into operation in record short time. Sparse networks are used here for drilling in combination with an intensive system acting on a bed (internal, unit, focal, selective and platform flooding). This has made it possible to decrease substantially the amount of drilling in hard-to-reach regions, to reduce capital outlays for organization of the fields, while preserving the high rates for development of deposits.

One of the fundamental questions of the problem of maintaining plastic pressure by the method of pumping in water is selection of water supply sources. Using surface waters for these purposes, for example, under conditions in Western Siberia would require the construction of expensive water storage places and purification structures, and laying long water lines. In order to avoid this studies were made of underground water and it was discovered that waters of the Apt-Alp-Senomanskiy water bearing complex could be used for flooding, which had the same chemical composition as the contour waters of oil horizons. At the present time pumping in ground waters is widely used at all deposits in Tyumenskaya Oblast.

Deposits in Western Siberia are located in a swamp region, which is practically impassable in the spring-summer-fall period. In such conditions the question of how one could drill became acute. The solution adopted was to drill deposits in clusters of obliquely-oriented wells with special earthen foundations--a huge technical and economic undertaking, which allows one not only to achieve high rates of drilling operations, but also to achieve a significant economic result in comparison with sinking wells from individual foundations.

Here we are presenting only the basic tendencies in the development of the scientific and technical progress in the industry and individual examples. Overall in the industry and especially at Western Siberian sites numerous measures were undertaken to intensify the inflow of oil into bottom holes of wells, for selecting optimal methods of their expectation, for automation of the processes of their recovery, gathering and preparation of oil and pumping water. All of these measures led to a significant increase in efficiency in developing the petroleum industry. For example, in the 8th Five-Year Plan, a 34-percent growth in labor productivity was obtained due to the introduction of achievements of scientific and technical progress, and in the 9th there was a 95-percent increase. In the 10th Five-Year Plan the entire increased yield planned for the petroleum industry should be obtained while keeping the count at the former level, i.e., completely due to the increase in labor productivity. Moreover, in the current five-year plan there has not yet been any favorable effect of natural factors, on the other hand, natural factors have begun to have a negative effect on the growth process of the industry. Consequently, the task of scientific and technical progress is not only to assure growth of labor productivity, but also to compensate for the worsening of mining and geological conditions of extraction, which is caused by displacement of a center of growth of the petroleum industry to hard-to-reach provinces with severe climatic conditions.

Further effective development of the petroleum industry is only possible on the basis of accelerated introduction of the most modern achievements of science and technology into production. And although the effectiveness of modern technological processes, modern materials, chemical reagents, machines and equipment increase along with the growth of science and technology, the expenditures required for their realization also increase. There is a concomitant lengthening of the time periods for creating the most modern methods and introducing them into industry. Under these conditions a problem of forecasting and selecting the most effective tendencies of scientific and technical process and of developing a single technical policy for their future prospects which would embrace several five-year-plans has become an urgent problem. In the decree of the CPSU Central Committee and of the USSR Council of Ministers "on improving planning and supporting the actions of management for improving production efficiency and work quality" it is mentioned that this can be done by developing multipurpose programs for solving the most important scientific and technical problems.

As applied to the petroleum industry the program-target method of planning scientific and technical progress envisages the following three stages:

--a retrospective analysis of the scientific and technical and economical tendencies in the industry and clarification of the joint technical and economic problems;

--setting goals for industry development, determination of the fundamental and most effective directions of scientific and technical progress and elaboration of a system of balanced indicators which must be achieved as a result of scientific and technical progress;

--determination of specific scientific and technical and organizational programs, which will assure achievement of the assigned goals for industry development.

In this manner, in conformity with the program-target method of planning, first goals and assignments are established, and then effective directions for their achievement on the basis of scientific and technical progress are selected.

The main purpose of the oil industry is to assure current and future demands of the national economy in oil and oil products. Reference figures for oil production based on planning years, which are given by USSR Gosplan to the Ministry of the Petroleum Industry, represent the assignment (target) for its growth. Simultaneously reference figures are established for increasing labor productivity are set by governing bodies, which are determined on the basis of the principal problems in the development of the national economy for the period being planned and of demographic predictions for the growth of labor resources in the country.

The Ministry of the Petroleum Industry, having assigned levels of petroleum production, in turn, sets the required amounts for growth of reserves, which is based on providing the industry with an optimal amount of raw material resources, amounts of recovered casing-head petroleum gas, length and construction sequence of new oil pipelines. Later, on a basis of growth analysis and investigation of specialized sites according to the main technological subsystems--preparation of reserves, drilling exploratory and operational wells, production of petroleum gas, main line transport of oil--assignments are made for increasing labor productivity. Each of the enumerated subsystems should assure fulfillment of the assigned tasks (target) by virtue of accelerating introduction of achievements of scientific and technical progress. To do this, target programs are compiled for each subsystem, which are mutually connected both within a subsystem and for the industry as a whole.

On the foundation of a detailed study of the peculiarities of petroleum industry growth in the past 15 years, and also taking into account the oil production levels which are predicted, the main institute of the industry in the area of economics, VNIIOENG, carried out a project to establish target indicators and to form comprehensive programs of scientific and technical progress according to the following sub-branches of the petroleum industry:

--prospecting-exploratory operations;
--development of petroleum deposits;
--drilling exploratory and operational wells;
--oil production;
--production and refining of petroleum gas;
--pipeline delivery of oil.

Comprehensive programs for distributing prospecting and exploratory operations, increasing their effectiveness and reducing the time periods for opening up new gas and petroleum provinces, which are interconnected with the assignment for increasing oil reserves for the future have been developed in the area of geological prospecting operations.

In the area of development of oil deposits target programs envisage improvement of existing systems of operations by using traditional methods of regulation and the use of the set of new methods for acting on the bed.

Mutually coordinated targets have been established and the basic indices of three comprehensive programs for improving well-drilling processes have been determined. The first program embraces the problem of reducing the cycle of constructing prospecting and operational wells, the second includes improving the methods of discovering and testing productive beds and the third comprises reducing unit labor expenditures in drilling.

Numerous problems in the area of technology, of the technology of oil extraction, of underground and capital repair of wells are combined into comprehensive programs for improvement of methods of intensification of oil inflow into bottom holes of wells, improvement in techniques and technology of oil production, improvement of the methods used in current and capital repair of wells, reduction in unit labor expenditures for oil production.

Target assignments have been established and recommendations for the formation of programs for increasing effectiveness in using petroleum gas resources, improving the reliability and reducing labor expenditures in operating pipelines have been developed.

Each target program consists of numerous tasks, whose solution in total assures fulfillment of the set target. By selecting both individual methods for increasing effectiveness of production as well as the amounts of them introduced, optimum conditions for fulfilling the entire program have been established.

In order to understand the sequence of solutions to these problems we shall examine the comprehensive program for increasing oil production by virtue of new methods of influencing beds. This program envisages the use of thermal methods pumping in solutions of alkalis, which are thickened by water polymers, a water gas mixture, etc. Each of the enumerated methods has its effective area of application. Thus, for example, pumping heat carriers into a bed is effective when the bed oil has increased viscosity, but the productive horizons lie comparatively shallow. Naturally, pumping in heat carriers should be planned above all for deposits, which have these properties. With an increase in volume, the use of the method of thermal action on a bed should envisage this process even for facilities with a less viscous bed oil and at great depths. Consequently, the effectivness of the method will drop unavoidably along with an increase in the volume of its introduction. This relationship is shown graphically in Fig. 1. Initially, the additional production quickly increases along with a growth in the volume of the methods introduced, and then the curve levels out (facilities which are less suitable for this method are switched in). Such curves which are called a function of expenditures, are constructed for all the methods enumerated and for each of them optimal volumes of introduction are determined ("0" on Fig. 1), which ultimately yield the growth rate for petroleum production mentioned by the program as a whole.

The problem of selecting the optimal sequence for introducing the programs themselves arises in the course of working on target programs. This is due to the fact that certain kinds of resources can be used in several purposes. Thus, for example, a number of chemical reagents are used for increasing petroleum production, intensification of inflow and improvement of discovery method. Because resources are always limited, it behooves one to give preference to those programs where a given reagent yields the greatest increase in additional petroleum production.

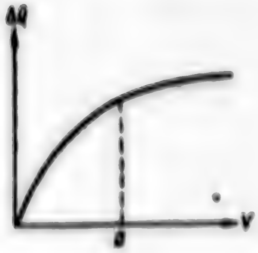

Fig. 1. Relationship of Additional Oil Production (ΔQ) to the Volume of the Introduction of Measures (V)

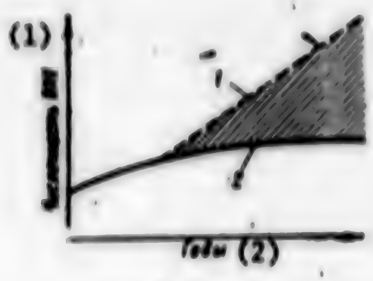

Fig. 2. Changes in Time of the Count Without Consideration (1) and With Consideration (2) of Scientific and Technical Progress.

Key:
1. PPP count
2. Years

In order to evaluate the efficiency of the target programs being planned industry indicators and its separate subsystems are determined from the beginning for a standard version which does not take into account scientific and technical progress, and then with consideration of its accelerating introduction. As an example, we can examine the determination of the count of industrial-personnel (PPP) in petroleum production. A sharp increase in the volume of operational drilling is planned for the coming years, which leads to a corresponding increase in a number of active wells. If the unit labor expenditures established at the present time are preserved, then the count of workers in the category under consideration will increase as shown in Fig. 2, curve 1. Considering the great importance of petroleum in the national economy of the country such an increase in the count cannot be assumed. It should remain at the level achieved at the present time (Fig. 2, curve 2). The shaded area in the drawing represents the assignment for scientific and technical progress which must free up the corresponding number of people by automation, tele-automation and improvement of management systems.

The method for planning scientific and technical process which is set forth is an active one: specific targets are set and programs to achieve them are designated. It should be noted that in modern production sales this method is the only suitable one.

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FUELS

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DETERMINING OIL SATURATION OF RESERVOIRS AT WEST SIBERIAN FIELDS

Moscow NEFTEGAZOVAYA GEOLOGIYA I GEOFIZIKA in Russian No 12, Dec 79 pp 6-9

[Article by V. N. Korchemkin, N. D. Yevko, and Yu. A. Koval'chuk, Siberian Scientific Research Institute of the Oil Industry: "Results of a Comparison of Direct and Indirect Methods of Determining the Oil Saturation of Polymictic Reservoirs in the Example of the West Siberian Oil Fields"]

[Text] The reliability of an oil saturation analysis of productive beds has great importance in computing supplies, planning development, intensifying extraction of oil, determining the current and final coefficients of oil output, etc.

Oil saturation, as is known, can be determined by direct and indirect methods. The primary purpose of the direct methods is to work out indirect methods from them that can be divided into field-geophysical and methods of creating water in the core samples under certain experimental conditions. The main geophysical method is the generally known method of resistance using the experimental dependences of the saturation parameter on water saturation. For intercalations in which it is difficult to evaluate the saturation by resistance a technique of determining oil saturation is used that takes into consideration the permeability and height of the interval above the OWI [oil-water interface]. For the very argillaceous, finely interstratified beds techniques are used that take into account the stratified and scattered clayiness.

Of the indirect core sample methods the most widely employed in mass analyses is the centrifuging method that is the fastest and simplest. Due to the perfection of geophysical methods and a number of their advantages over the core sample methods they have been used more and more recently. The core sample methods are mainly employed as additional and are usually used to verify the geophysical methods in the oil section of the bed to determine saturation in the crest sections of the deposits (at a height of over 50 m above the OWI), as recommended in work, as well as to pinpoint the upper part of the curves for the dependence of saturation on the height above the OWI with known α_{cn}. At the initial stage the saturation of beds made of little-studied rocks for which geophysical methods have not yet been sufficiently worked out is evaluated from the core sample (for example, the beds of the Yu. Megionskiy field, bituminous argillites of the bazhenovskiy series, and others). The most important purpose of the core sample methods is construction of relationships necessary for an analysis of saturation from geophysical data.

One of the features of the oil beds in the West Siberian fields is the presence of transitional zones that are considerably thick (20-40 m and more). In this respect these zones are often differentiated into three for a more accurate calculation of the supplies and successful development of such fields. Taking into consideration the great thicknesses of the transitional zones in West Siberia, as well as the possibility of obtaining practically anhydrous oil from part of them, such zones have often been called zones of undersaturation.

However, it is more expedient to thus name not the entire transitional zone, but only its upper part from which the anhydrous supplies of oil are obtained. This part of the bed that often occupies a considerable fraction of its volume is actually undersaturated with oil, therefore such a name for it is quite applicable. In degree of saturation (due to the change in $K_{н}$ with height) it must be classified with the transitional zone, and in nature of the inflows--with the oil-bearing. In work the section with anhydrous inflows and oil saturation that changes depending on the height above the selected level, i.e., the aforementioned section of the transitional zone, although it is separated into an individual zone between the transitional and the zone of maximum saturation, is still called the undersaturated zone.

It is expedient to understand by the oil-bearing part of the bed the zone of maximum oil saturation and the zone of undersaturation, i.e., that part of the bed from which anhydrous inflows of oil are obtained; by transitional--the region of obtaining oil with water; and by water-bearing--the region of obtaining water.

The study of oil saturation by the direct method for a number of wells has been finished by now in West Siberia, which makes it possible to give a sample evaluation of the reliability of the indirect methods employed here. The removal of the core sample for these wells is usually 70-100%, diameter 60-80 mm. Studies were made according to the generally accepted techniques with high density of the analyses (usually in 5-10 cm). A correction was introduced into the results of the water saturation analysis by direct method for the bed conditions that in the majority of cases is 1-2% of the pore size, and for the very argillaceous highly-porous reservoirs with high water saturation it increases on the average to 3-4%. The external control on the same samples in the organizations where the core sample was studied showed close results.

Of the wells where the saturation was determined by the direct method, two were drilled on the Sovietskiy field (well 320-bis and 64). They mainly revealed the upper bed AB^1_1 of layer AB_1. The studied sections are represented by sandy-argillaceous-aleurite rocks, fine- and lens-like-stratified, the majority of them belong to the type known by the name "ryabchik." The rocks are cemented with argillaceous material that holds, besides the main component, kaolinite, chlorite, hydromica and mixed-stratified formations of a series of montmorillonite-hydromica.

In the region of well 64 reservoirs of IV-V classes (according to A. A. Kahnin) dominate, while in the region of 320-bis--IV (less often III and V) class. From certain samples of well 64 part of the fluids was evaporated, therefore the data from them were not considered. On the average, half of the pore volume in these beds is occupied by water; its content varies from 25 to 70% and more.

The third well (well 107) was drilled in the central section of the Samotlor field. Analyses were made in the central laboratory of Glavtyumen'geologiya. Core samples were studied from the beds AV_{2-3}, AV_{4-5}, BV^0_8 and BV_8. Beds AV_{2-3} are made of argillaceous-aleurite sandstones. The majority of rocks are reservoirs of I-II classes, the average content of sandy fraction in them is 60-70%, argillaceous--9%. The average permeability of AB_{2-3} beds is 1,740 mD, AV_{4-5}--1,100 mD. The cement is mainly porous, and is primarily kaolinite in composition. The OWI is revealed in the lower part of the AV_{4-5} beds, while the entire segment above the strictly transitional zone belongs to the zone of undersaturation (about 20 m). In this respect the bed water saturation of the rocks from the data of the direct method is high here, on the average 30%; in the AV_{2-3} beds (zone of maximum saturation) it averages 18%.

The beds BV^0_8 and BV_8 are also composed of sandy-aleurite rocks. The content of argillaceous fraction in the main productive bed BV_8 is somewhat lower than in the beds AV_{2-5} (on the average by 2%). The cement is also film-like, and of chlorite composition. Rocks of the IV class dominate in the BV^0_8 bed, and of III and II classes in the BV_8 bed. The water saturation is correspondingly higher in bed BV^0_8--on the average 32%, and in bed BV_8--22%. The studied sections, with the exception of beds AV_{4-5}, belong to the zones of maximum oil saturation.

Recently a study was made on the core sample in well 106 of the Var'yeganskiy field (Glavtyumen'geologiya, N. A. Pikh et al., 1977). Beds BV were mainly studied. The properties of the productive bed rocks in this well and at the Samotlor field are similar, which is confirmed by the proximity of the curves for the relationship $K_{oo}=f(K_{np})$ constructed from them. However, in contrast to well 107 reservoirs of the III-IV classes dominate here, and the water saturation of the beds is more often 20-40%.

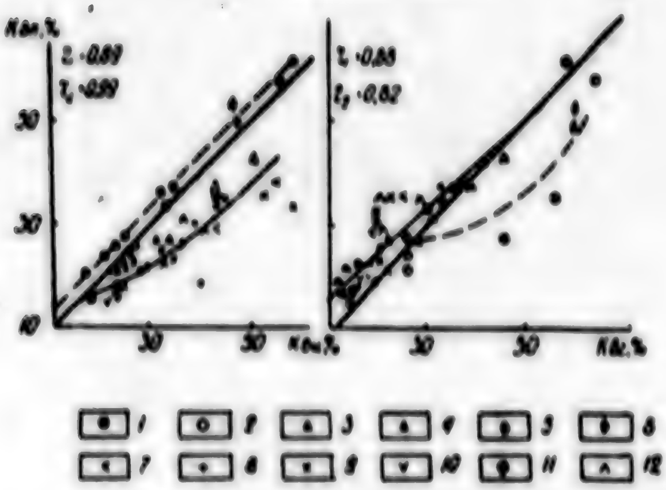

Figure 1. Comparison of Results from Determining Water Saturation by Direct ($K_{вп}$), Centrifuge ($K_{вц}$) and Geophysical ($K_{вг}$) Methods (Average Values for the Intercalations of Different Beds)

Key:

Samotlor field, well 107, beds
1. AV_{2-3}
2. AV_{4-5}
3. BV^0_8
4. BV_8

Sovetskiy field
5. bed AV_1, well 64
6. well 320-bis

Var'yeganskiy field, well 106, beds
7. BV_6
8. BV_7
9. BV_8
10. BV_9
11. BV_9 (zone of undersaturation)
12. BV_{10}

dotted line--averaged curves (2,5, 6,11) of relationship for undersaturated zones of beds

solid line--for zone of maximum saturation

η--correlations of links; correlation coefficients for zones:

r_1--maximum saturation

r_2--undersaturation

Comparison of the water saturation determined by geophysical, centrifuge and direct methods for the intercalations is given in figure 1, and the curves for the samples to evaluate $K_{вп}$ through $K_{вц}$ --in figure 2.

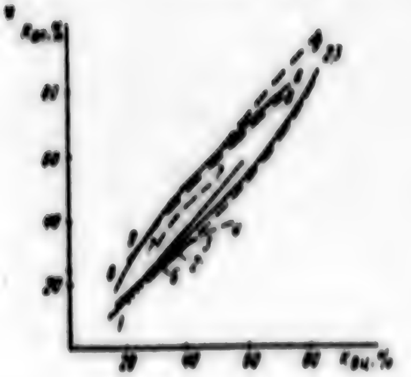

Figure 2. Curves for Relationship $K_{вп}=f(K_{вц})$ to Evaluate Water Saturation of Productive Beds from Results of Centrifuging Method

Key:

Zone of maximum saturation
Samotlor, well 107:
1. AV_{2-3}
2. BV^0_8
3. BV_8
4. Var'yeganskiy, well 106, BV_{6-10}
5. Fedorovskiy, well 120, VS_{10}

Zone of undersaturation:
6. Samotlor, well 107, AV_{4-5}
7. Var'yeganskiy, well 106 BV_9
8. Sovetskiy, well 64; AV_1
9. Sovetskiy, well 32-bis, AV_1

The water saturation from geophysical data in the beds AV_{2-3} and BV_8 (well 107) was underestimated on the average by 5% (usually from 4 to 6%), in the beds AV_{4-5} (zone of undersaturation), on the contrary, it was higher than from the data of the direct method by 5% (usually from 3 to 6%), and in the bed BV^0_8 the results practically coincided (from the geophysical data higher by 1-2%). For the beds BV (well 106) in the zones of maximum saturation the water saturation from the data of geophysics in the intercalations formed of slightly argillaceous reservoirs with $\alpha_{sp} > 0.8$, practically is the same as from the data of the direct method (less by 1.3% of the pore volume), and in the argillaceous with $\alpha_{sp} < 0.8$ (they dominate in the section of the well) it is lower on the average by 7%. The water saturation from the data of geophysics in beds AV_1 (well 320-bis and 64) is lower than from the data of the direct method on the average by 6-10%.

Comparison of the results of the centrifuging method with the data of the direct method demonstrated that the average values for the intercalations in different beds are close to the average for the samples. An exception is the beds BV_{6-10} in well 106 of the Var'yeganskiy field in which for the zones of maximum saturation (data of studies on 137 samples) $K_{вц} > K_{вп}$ on the average by 5.6%, and for the intercalations--by 9%. The latter amount is overestimated due to the inclusion in the sampling of a considerable number of intercalations with reduced properties (intercalations with $K_{\text{вц}} > 40\%$ comprise more than one-third of all those studied). In well 107 $K_{\text{вц}} > K_{\text{вп}}$ for the intercalations of beds AV_{2-3} and BV_8 on the average by 3.5% (more often by 2-5%), in beds AV_{4-5} (zone of undersaturation)--less than 4% (from 3 to 5%), and in the bed BV_8--higher than 7% (from 5 to 8%). For well 320-bis the water saturation of level AV_1 was higher than $K_{\text{вц}}$ on the average by 8%, and for well 64--by 3.5%.

The increased water saturation of the studied section of level AV_1 in the region of well 320-bis was due to its geological peculiarities. The nonuniformity over the section and the area in the region of well 64 also was high, but less than in the region of well 320-bis, and this well was located closer to the center of the deposit. This determined the lower content in it of rocks of free water. The sections of these wells are located above the OWI by 28-45 m, but nevertheless, they are undersaturated with oil. In this respect one can assume that in the beds similar to the bed AV^1_1 the zones of undersaturation can be over 30-40 m thick. The water saturation of beds AV_{4-5} in well 107 and the lower part of bed BV_9 in well 106 that is higher as compared to the data of centrifuging is due to the fact that they are located at a distance less than 25 m from the OWI, i.e., belong to the zones of undersaturation. In the transitional zone the difference in $K_{\text{в}}$ must increase, which was confirmed in practice. Thus, for the intercalation located in the upper part of this zone in well 107 the difference rose to 12%. Evidently, with an evaluation of the saturation in the transitional zone it is impossible to use the patterns of centrifuging employed for the oil-bearing section. It is better to determine the oil saturation in this zone only from geophysical data since part of the moving water in the core samples during drilling can be displaced by the oil-base solution penetrating them.

For all the wells drilled with the use of an oil-base solution the links between $K_{\text{вц}}$ and $K_{\text{вп}}$ for the oil-bearing section of the beds are characterized by high correlation ratios (usually 0.9 and higher), which makes it possible to use data on $K_{\text{вц}}$ for an analysis of $K_{\text{вп}}$ with the help of these links or the corrections indicated above without changing the pattern of centrifuging used in SibNIINP [Siberian Scientific Research Institute of the Oil Industry] and Glavtyumen'geologiya. The links $K_{\text{вп}} = f(K_{\text{вг}})$ are also characterized by fairly high correlation ratios (0.82-0.97).

Conclusions

1. The results of a comparison of the direct and indirect methods for determining oil saturation of reservoirs in the West Siberian oil fields indicate the need to correct the indirect methods, especially for argillaceous reservoirs.

2. Average values for the oil and gas saturation in stabilized zones of the beds of valanzhin and goteriv-barrem in the Central Priob'ye fields are usually higher according to the geophysical data , and according to the centrifuging method they are lower than the actual by 4-6% (abs). In the undersaturated zones of these beds the difference on the average in amount is the same, but has the opposite sign. Due to the high micro- and macroheterogeneity in the beds AV$_1$ (Aptian stage) the error in the indirect methods is often still higher (from -6 to -10%).

3. With the use of oil-base solutions the wells should be drilled with mandatory detection of the zones of maximum oil saturation of the beds in order to determine the oil saturation by the direct method.

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UNRESOLVED PROBLEMS OF OIL AND GAS PROSPECTING

Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian No 3, Mar 80 pp 127-130

[Article by G. G. Ovnatanov, Candidate of Technical Sciences, Winner of the State Prize of the USSR, Aprelevka Branch of All-Union Scientific Research Geological Petroleum Prospecting Institute]

[Text] The number of dry holes which did not yield products and moreover which did not provide valuable information many years ago in prospecting work comprises almost half of all boreholes. Moreover, the extensive experience accumulated in Bashkiriya, Orenburgskaya Oblast, Uzbekistan and also abroad indicates that commercial flows and sometimes even oil and gas gushers can be produced from any "dry" holes by modern means of organization. Considerably more wells will be drilled due to the inadequate prospecting information per unit area than would be required with scientific organization and a high level of organizing exploratory and prospecting work.

The cost of exploratory and test wells continues to remain high and exceeds the cost of exploitation wells; it comprises an average of 0.75-1.0 million rubles per well, while it is much higher for wells drilled in offshore fields. The cost of a meter of drilling increases from year to year. The cost of testing per meter of drilling is also increasing; it has doubled during the past five years.

There are frequently cases when a test column is lowered into a well for brief testing (2-3 days) for formal completion of work and to receive money from a bank, after which the borehole stands idle for years. Practice shows that the desire to twice utilize drilled wells (for exploration and testing and then for operation of it) leads in many cases only to burial or in the best case to freezing of casing strings for many years. According to our preliminary calculations, no fewer than 160,000 tons of casing string of high alloy marks of steel have now been buried and frozen.

The productive time of test teams has been utilized by 36-40 percent universally over a period of many years due to the extremely poor supply with tools, tranrport and equipment. The number of wells completed by drilling and awaiting testing is not being reduced and the high rates achieved by the drillers are undervalued. The deadlines for well testing sometimes exceed the drilling time. Every year, 15-20 percent of the wells completed by drilling are not tested and testing is postponed to the following year. There are many cases when a well waits several years for testing.

The system of planned indicators (meters, rates or number of wells completed by drilling and construction) suitable for exploitation drilling is mechanically applied to exploratory and test drilling, although it is obvious that the goals of these two directions of deep drilling are essentially different. The final result for exploratory and test drilling is to obtain valuable scientific and geological information and to discover oil and gas fields, to which the planning indicators obviously should primarily correspond.

Selection of the final diameter of exploratory and test wells requires consideration of the economics, equipment and technology of all geological, exploratory and prospecting work. Hundreds of small exploratory and test wells have already been drilled in the country and their feasibility has already been proved in practice. Nevertheless, small-diameter exploratory and test wells are not being introduced although it is difficult to even imagine the effect which this would provide to the economics of exploratory and prospecting work and for acceleration of it.

Large reserves are being wasted in combination of drilling and testing of wells during a single production process--the principle of simultaneity, which provides direct exploration of oil and gas pools during drilling in an open shaft.

Drilling organizations are large enterprises supplied with the necessary equipment and staffed by qualified engineering and technical personnel. The means of geological investigation of a profile, testing and exploiting a bed in an open shaft and extensive investigation of it have considerably lagged behind the technical level achieved in drilling.

Planning bodies, relying on the method of a compulsory annual increase of volumes, are increasing the volumes of drilling work without placing significant requirements on technical re-equipping of exploratory and test drilling of wells, testing of them, disposition of wells and especially on the quality of geological work carried out. In some geological organizations, the number rather than the high level and the serious scientific justification of work are taken.

An intolerable situation has been established when it is easier to drill tens of wells on an area, having expended 5-15 million rubles for drilling, than to carry out hydraulic fracture of the bed, acid-base treatment or deep wedging of microcracks in one of them, having expended only 15,000-25,000 rubles, although a clear answer to many questions arising on the exploratory-test area can be obtained from the results of completing the latter operations rather than continue in the obscurity of further exploration and prospecting. But there is almost no universal technical base, storage and transport depots for acids and reagents and no specialized enterprises for these processes. Potentially promising beds are frequently related to "dry" holes for this reason. This is especially true of carbonaceous rock in which inducement of oil flows is complicated by geological conditions.

Transposition of the industrial and test stage of prospecting work to geologists and the desire to obtain areas from them with high categories of reserves ($A + B_1$) are extremely serious consequences and one cannot proceed further in this direction! Diverting the forces and funds of geologists to the prospecting stage weakens attention to regional explorations and exploratory work: the plans for drilling parametric and test wells are not being fulfilled. Structures promising with regard to oil and gas content, ready for drilling, begin to experience a famine, serious errors are beging committed in the direction of exploratory work and the number of unconfirmed structures is increasing. Because of this, there may be a slowdown in preparation of reserves of commercial categories.

The Most Important Measures

The following measures significantly accelerate the technical progress and improvement of oil prospecting work:

scientificially justified selection of sites entered for test drilling;

separation of the geological, exploratory and prospecting process into stages where essentially different geological problems are solved and where the responsibility of the executor for each of them is clearly defined;

re-equipping of the subsector and orientation of it toward construction of wells corresponding especially to exploratory and prospecting goals --with the smallest possible final diameter of the shaft and exploitation column;

introduction of combined deep drilling and extensive investigation of wells by all existing methods, means and procedures for investigation of the geological profile which science in practice have at their disposal to exploratory and prospecting work. The main advantages of this combination are a freshly discovered bed, operational geological information, a multiple reduction of the cost of the testing process and a reduction of the well construction deadlines. Calculations and accumulated experience show that the cost of drilling one well is reduced by 100,000-150,000 rubles with the combined cost of drilling and labor productivity is increased by 15-20 percent.

We feel that the geological service should be completely reorganized from top to bottom, bringing the activity of all subdivisions closer to the primary scientific research and production complex. This requires that all types of investigations and field determinations of flow be set up by organizing continuous round-the-clock maintenance of existing boreholes of all necessary profiles by investigators.

The mechanism of interaction among oil (gas) production enterprises and geological, exploratory and prospecting organizations can be improved by strict specialization, clearly dividing the functions and responsibility for fulfillment of geological and prospecting stages of exploratory and prospecting work among them.

It is important to orient engineering policy in geological, exploratory and test drilling toward reducing the mass of the drilling, test, power supply and production equipment and tools and also test stations of different designation. Independent machine building and instrument building bases for geological, exploratory and test drilling can be created by using machine building plants which have operated previously in this field.

The following regulations can be worked out:

creation of specialized firms to service boreholes by research and laboratory work and parties for treating the bed and cementation of wells by flushing and working fluids;

training of specialists in well testing and field geology and also increasing the qualifications in these specialities in the higher educational institutions of the country.

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TYUMEN' HIGH SPEED DRILLING: SUCCESSES AND FAILURES

Moscow EKONOMICHESKAYA GAZETA in Russian No 18, Apr 80 p 15

[Article by V. Dubrovin (Tyumen'): "To High Speed Drilling"]

[Text] There is a saying in Western Siberia -- "Petroleum is at the end of the drillers' drill." This is actually so: advanced rates of drilling wells are pledges of successfully meeting goals on extracting hydrocarbon fuels from the earth.

The present stage of the comprehensive assimilation of the petroleum resources of Western Siberia is characterized by a sharp increase in sinking wells. Here are some figures. From 3.2 million meters in 1976, volume doubled last year. This year, Tyumen' drillers must drill petroleum wells with total depth of over 9 million meters. These rates will be continued also in the near future.

Here is another feature. The entire country is helping assimilate new deposits 200 to 300 kilometers away from primary bases and highways. And not only with material resources. Drillers from other regions are attracted to sinking the wells. Over 50 brigades from the Ukraine, Belorussia, Tatariya and Bashkiriya, working on the watch-expedition method, account for over a quarter of all drilling.

Advanced Experience Teaches and Proves

The achievements of the Tyumen' drillers are widely known. Strong collectives were formed here and a great amount of experience in operating under difficult natural-climatic conditions was accumulated. The slanted sinking of wells from a "cluster" is widely used. Ten to 15 more slanted bores are drilled fan-wise from one base which saves a great amount of work and money. The Middle Priob'ye is famous for outstanding labor records in industrial competition. Thus, for a number of years, collectives of the Nizhnevartovskoye Drilling Administration (UBR) No 1 and the Surgutskoye UBR No 2 achieved the highest drilling rates per worker for the industry. Modern equipment is being introduced persistently, technology is improving and efficient forms and methods of working competition are being used. Last year, drilling collectives initiated a competition for sinking an average of 70,000 to 80,000 meters of wells per brigade, while advanced brigades competed for drilling 90,000 to 100,000 meters.

Twenty-one December 1979 became a famous landmark. V. I. Volovodov's brigade from the Surgutskoye UBR No 2 reached the 90,000-meter goal in drilling for the first time in the industry. The Nizhnevartovskiye drillers, in their turn, took a decisive step forward. Following the collective of G. M. Levin, Hero of Socialist Labor, the brigade of A. D. Shishkin, Hero of Socialist Labor, also passed the 90,000 meter mark. The young collective of foreman A. D. Spitsin (Surgutskoye UBR-2) finished with the leaders. Tens of collectives overfulfilled their obligations. The successes of the advanced workers confrimed the fact that Siberian drillers have great reserves.

However, as a whole, Glavyumennegtegas did not cope with last year's plan. The average sinking per brigade did not increase. The difference between the indicators of leading and lagging brigades increased.

Build-Up of New Brigades

Complaints are heard in the Glavtyumenneftegas about the complicated drilling conditions at remote deposits and about attracting new brigades that have insufficient experience. Actually, the total number of brigades that use the watch-expedition method mainly increased last year by a time-and-a-half and continues to grow. It cannot be said that the main administration is indifferent to beginners. As a rule, newly-created brigades are trained for a month or a month and a half in the collectives of the best foremen, and they are given courses in slanted drilling. Many young specialists have been trained in schools of advanced experience. A part of the new brigades reached the 50,000 meter drilling goal in a short time.

But, as a whole, the process of building up new brigades stretches out unjustifiably due to poor organization and technology violations. Frequently new collectives are created where even the existing ones do not have a work zone. One's attention is drawn to the fact that in the last 5 years the indicator for the average sinking per drill bit has not increased although the tool was improved. The transfer of collectives with advanced experience to lagging collectives is not being considered in the main administration as mandatory business, and is limited by general appeals and wishes.

At the same time, managers of drilling administrations in other regions, for example, the Yershovskiy ("Saratovneftegaz" Association) and the Mirninskiy ("Kuybyshevneft'"), attracted by the assimilation of the Tyumen' deposits by using the watch-expeditionary method, are in no hurry to create bases and are slow to adopt local experience. Yet, messengers from Tatariya, Bashkiriya, Ivano-Frankovsk and Gomel' are in a fighting mood and are already becoming worthy rivals of experienced Siberian workers.

Weak Links in the Relay Race

To stimulate competition between brigades working under different conditions, a regulation on the competition was developed that specifies goals for groups of deposits. This makes the results in which the main indicator remains the fulfilling of the plan in meters, comparable to a certain degree.

However, it is well known that, in themselves, meters drilled do not insure the final goal -- an increase in the production of petroleum. In the technological chain of building a petroleum well there are, besides drillers, many specialized services and organizations. To direct all the efforts to a single goal -- placing the wells in operation most rapidly, the Glavtyumenneft turned, 3 years ago, to the brigade-relay race form of organizing competition. Its basis is a network schedule which includes in the sequential order of brigade work the following: builders of bases for "clusters," transportation workers, derrick installers, drillers, workers for insuring the petroleum flow and connecting the wells to the petroleum collecting network. The idea is that all participants in this relay race must compete on the basis of mutual obligations, conclude contracts with related specialized enterprises, specifying schedules, quality, material consumption etc. The orders were issued by the main administration, the industrial obkom of of the trade union and associations. Regrettably, the organizational measures outlined were not enforced. Soon weak links were detected in the relay race chain.

How the brigade relay race became a mere formality may be seen in the "Yuganskneftegaz" Association. Here, bonuses were given not for the coordinated single movements of everyone toward a common goal, but for the fulfillment of a single stage of work. Builders, transportation workers, well-pluggers and geophysics personnel were found to be outside this relay race. And yet, without these related trades, the well cannot be drilled and connected to the collecting system.

Moreover, the planning and evaluating indicators were found to be different: for drillers -- in meters; for pluggers -- in rubles; for derrick installers -- the number of rigs. In other words, there has been no link-up so far between drillers and workers in related trades. Last year each drilling brigade was idle for 24 days on the average because of the derrick installers alone.

We asked the departments of labor and wages of the main administration for an explanation. They told us that in 1979 a brigade-relay race was implemented fully at three "clusters" in Surgut and Nizhevartovsk. Good results were obtained. Yet, even as the experience is being disseminated for mass use of the progressive method -- it was impossible to obtain a conclusive method. Meanwhile the new form needs to be improved and introduced energetically.

Beyond the Framework of Departmental Boundaries

The competition for maximum drilling per brigade per year by the Tyumen' workers stepped beyond departmental boundaries. One graphic example is the working cooperation between the Nizhnevartovsk and Taganrog metallurgical brigades who supply drilling pipes. The metallurgists visited Samotlor and concluded a competition contract. Since then the reliability of the pipe has begun to rise.

The pipe rolling workers of Dnepropetrovsk are searching for reserves to improve quality in contacts with the drilling workers. Yet, the output of the Azerbaydzhanskiy and Sinarskiy plants still evokes many complaints.

The acceleration in drilling depends on bottom hole power units. The Tyumen'workers need high-torque, slow-moving turbine drilling machines which, in combination with the new drill bits, can increase the drilling speed sharply. The Kingurskiy and Pavlovskiy plants of the Ministry of Chemical Machinery are called upon to produce the turbine drilling machines. However, the changeover of both enterprises to the production of the new machines was delayed with the result that these machines will not be available to drilling workers this year. We would like to cite the example of the Sverdlovsk workers. The Uralmashzavod, in cooperation with the Tyumen' workers, created the new 3000-EUK drilling rig in a short time. It was evaluated highly by the derrick installers and drillers who proposed a number of design improvements.

The Mintransstroy [Ministry of Transport Construction] subdivisions lag systematically. As a result, of the 15 Nizhnevartovsk deposits being worked, only five have roads that can be used year-round. Now, in this largest petroleum field in the country, half the increase in petroleum extraction must be produced by the Var'yeganskaya group of deposits while the laying of roads to it is being delayed by a year. This also applies to the construction of electric power transmission lines by the USSR Ministry of Power and Electrification. The Ministry of Industrial Construction subdivisions is slow in erecting housing and social-cultural facilities. In 1972, in that same Nizhnevartovsk, only 72,000 square meters of housing area were released for use instead of the planned 236,000 square meters.

The Tyumen' drillers are solving complex and responsible problems in the final year of the 10th Five-Year Plan period. In the first quarter they drilled 689,000 meters more wells than in the same period last year. But this should not generate any slackening. Ahead is the difficult summer-fall period with growing volumes of work.Its implementation requires special cooperation among all sections of well construction and an organization of efficient socialist competition.

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FUELS

WESTERN SIBERIAN PETROLEUM, GAS COMPLEX

Moscow NEFTYANIK in Russian No 4, Apr 80 pp 32-33

[Article by V. Klyucharev and Ye. Filippova, VNIIKTEP: "The Western Siberian Petroleum and Gas Complex: Achievements and Problems"]

[Text] The Western Siberian Petroleum and Gas Complex is of exceptionally great importance in the fuel and energy potential of the country. This region accounts for nearly half of the all-union production of petroleum and gas condensate. During the short period since 1964, when the first deposits--the Ust'-Balykskoye, Trekhozernoye and Megionskoye--were discovered and put into operation, the main petroleum-producing base of the country has been created here. A typical feature of the development of the petroleum industry in Western Siberia is the scale and growth rate of petroleum production (the dynamics of petroleum production by years is shown in the table).

Years	Production volume, millions of tons	Annual increase of production	
		millions of tons	percent
1964	0.2		
1969	21.3	9.1	42.7
1974	116.4	28.7	24.7
1975	148.0	31.6	21.4
1976	181.7	33.7	18.6
1977	218.3	36.6	16.8
1978	254.1	35.8	14.1
1979	283.5	29.4	10.4
1980 (plan)	314.9	31.4	10.0

The petroleum deposits of Western Siberia are concentrated in the Central Ob' River region, to the south, southeast and north of it, as well as in the Urals area (to the west of the Central Ob' River region).

More than 90 percent of the proved reserves of petroleum on the territory of Tyumenskaya Oblast are concentrated in the Neocomian complexes (Lower Cretaceous deposits). A lower (Megionskiy) series with productive beds of group B and an upper (Vartovskiy) series with beds of group A have been distinguished here. The beds B_{1-3} and B_{6-8} are relatively more uniform in capacity and area of occurrence and are notable for a high productivity. The beds A_{1-5}, B_{10-11} and B_{17-20}, as a rule, are very nonuniform and are characterized by a lower productivity. sandstones and aleurolites with argillaceous carbonate cement serve as the collectors of the petroleum. The presence of vast water-oil zones is typical of the petroleum formations in the beds of group B, while the presence of gas caprocks, which amount to 30-80 percent of the area of the formations, is typical of the formations of group A. The oils of the deposits of the Central Ob' River region are light with a sulfur content of less than 1 percent.

The oil content of the underlying argillo-arenaceous deposits (the Achimovskiy, Bazhenovskiy and other series) so far has been inadequately studied.

Deposits with oil formations in sandy aleurolitic rock of the Upper Jurassic and Lower Cretaceous have been discovered to the south and southeast of the Central Ob' River region. The beds have a low capacity and low filtration properties. Oil formations are also encountered in a thick series of Paleozoic formations. Here they are connected with carbonate collectors of the interstitial type, which have a low productivity. The petroleum of all the formations, as a rule, is light and of low viscosity. But the formations in these deposits so far have been inadequately studied.

To the north of the Central Ob' River region the oil formations are confined to deposits of the Lower and Middle Carbonaceous. The Jurassic complex of this region has been poorly studied, precise ideas about the prospects of its petroleum and gas content have not yet been formed.

In the Tyumen' Urals region the oil formations are connected with seams of coarse and medium-grained sandstones and aleurolites of the Tyumen' series, as well as with basal sandy formations of horizon P of the Jurassic. The crumbling rock of the weathering crust (horizon K) also is petroleum-bearing.

The high-yielding petroleum formations in Western Siberia are being developed at a stepped-up pace. Contour flooding is used extensively in the working of the petroleum deposits. Strip "block" systems of flooding with the three-row and five-row arrangement of the producing wells are being employed to expedite the achievement of the planned production levels. The central sections of the blocks are put into operation before the completion of the mapping of the formations with development wells, while the follow-up exploration of the peripheral sections of each block is carried out in the process of drilling the producing wells by a creeping system from the center to the periphery. This method expedites considerably the placement of petroleum deposits into operation and yields a great economic impact.

Due to the swampiness of the territory of the Western Siberian Depression the directional cluster drilling of several wells from one artificial base is being carried out at many deposits. The number of wells in a cluster is usually 8-18, while the maximum tailings of the bottom hole amount to 2,000 m.

The construction of objects from block and complete block plant-produced units has become widespread in the building of boreholes and the development of oil fields. Due to the lack of roads the large blocks are transported by catepillar trucks and helicopters. When developing the northern regions of Tyumenskaya Oblast with unstable permafrost soil the air transport of the blocks will be more preferable (with allowance made for environmental protection and the speed of cargo delivery).

During the 11th Five-Year Plan in order to offset the decline of petroleum production at the deposits being worked and to ensure the further development of the petroleum industry in Western Siberia it is proposed to develop a number of new deposits. In the future the number of deposits being discovered will be increased by means of the discovery primarily of small and medium-sized deposits with a complicated geological structure. The coefficients of the petroleum yield of such formations are low, while the working is less efficient. The increase of the number of deposits having a complicated structure will lead to a further increase of the capital investments on their development.

The conditions of working are also more complicated at the petroleum deposits which have been discovered, but not yet placed into operation: the Russkoye (with formations of high-viscosity petroleum), the petroleum and gas condensate Urengoyskoye (with formations under gas), which are located in a zone of permafrost, the Salymskoye (with formations of low-viscosity petroleums, which are connected with fissured clay shales), as well as at the petroleum deposits of Krasnolenskiy Rayon in the Urals region (with formations of low-viscosity petroleums in thin alternating interstratifications, which are notable for the lack of bottom waters--water-free formations). The methods of working these deposits are still at the stage of development.

Thus, for Western Siberia an increase of the number of deposits being worked and the complication of their working will be noted in the future. Moreover, the development of the deposits located in the northern part of Tyumenskaya Oblast will be accompanied by the even greater complication of the natural and climatic conditions (the development of permafrost, higher than usual swampiness, lower and lower winter temperatures), remoteness from major population centers, the deterioration of transportation links and so on. All this predetermines the need for the solution of important problems in the drilling of wells, the working of the deposits and the recovery of the petroleum and the quickest possible introduction of the latest achievement of scientific and technical progress.

In the area of well drilling the production of modern drilling equipment and the technology of building wells under the conditions of permafrost, especially the technology and equipment for the use of thermal methods under these conditions, have to be development and assimilated.

For the highly productive drilling of wells in the regions of Siberia it is envisaged to develop new designs of rock bits with sealed oil-filled bearings and to develop improved designs of diamond drilling tools for driving the lower intervals of deep wells.

The use of high-strength drilling pipe with welded joints will yield a great economic and technical impact.

In the area of the equipment and technology of recovering petroleum and working petroleum deposits there is envisaged:

the improvement and extensive adoption of the gas lift method of operating wells;

the development and introduction of methods of controlling the corrosion of oil field equipment;

the development of methods of affecting the critical zone of the bed for the purpose of increasing the influx of petroleum;

the introduction of the cyclical affecting of the formation;

the technical backing of the methods of increasing the yield of petroleum;

the assimilation of the technology and the extensive adoption of methods of increasing the yield of petroleum (the injection of aqueous solutions of alkali, surfactants, carbon dioxide, water-gas mixtures, the use of thermal methods and so on);

the adoption of area and selective flooding systems when working beds with a heterogeneous structure and inferior collector properties;

the development of the equipment and technology of working formations by horizontally branched wells.

Effective methods of preventing the formation of salts and paraffin when recovering petroleum have to be developed. In 1978 the formation of salts was noted in 250 wells and on many items of field equipment. The number of such items is increasing. Due to the formation of salts the overhaul life of wells at a number of deposits has decreased to 30-60 days. The extensive use of inhibitors of salt formation will provide an increase of the overhaul life of wells to 360 days, which will yield an additional production on the order of 1,000 tons of petroleum a year per well.

The further development of the petroleum industry in Western Siberia involves the solution of a set of problems on the development of deposits, the creation of a network of main pipelines and repair bases, the development of the production capacities of drilling and petroleum- and gas-producing enterprises and allied sectors of the petroleum and gas industry and the development of systems of power, water and heat supply. At the same time it is necessary in a short time to implement a considerable program of housing, cultural and general construction, in order to create the conditions for the influx of skilled manpower and to provide the necessary level of the satisfaction of the vital needs of the population in the new regions of Western Siberia.

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FUELS

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SIBERIA'S COAL RICHES MUST BE PUT TO USE

Moscow RAZVEDKA I OKHRANA NEDR in Russian No 4, Apr 80 pp 12-17

[Article by I. I. Molchanov (Institute of the Lithosphere of the USSR Academy of Sciences): "Siberia's Coal Basins are a Most Huge Base for Developing Industry"]

[Text] In the first years of the Soviet state's existence, V. I. Lenin, with the perspicacity characteristic of him, wrote in the article, "The Immediate Tasks of Soviet Power," about the gigantic reserves of natural resources of Russia, including coal in West Siberia. Prior to the Great October Socialist Revolution, Siberia's coal resources had been studied but very little. It was presumed that there were substantial coal reserves only in the Irkutsk basin and about 10 billion tons in the Kuznetsk basin, where coal mining had barely reached 1 million tons per year. During the years of Soviet power Siberia has been converted into the country's largest coal base. The main and more promising prospects for the industrial development of Siberia's coal deposits have been concentrated in its southern regions, in basins that are marked by high coal density of the productive formations. Their role for the economy of the country of developed socialism is ever-increasing. In L. I. Brezhnev's speech to the November 1979 CPSU Central Committee Plenum, the necessity for accelerated development of the Kansk-Achinsk and Kuznetsk fuel-and-power complexes was especially noted.

One of the country's most important coal basins is the Kuznetsk. As a result of geological exploration and study conducted in the Soviet era, its total reserves to a depth of 1,800 meters in quality-standardized coal seams are assessed at about 550 billion tons, which exceed by 10-fold those of the Donbass [Donets Coal Basin] that are accessible for use. The coal density of the formation is almost 20 million tons per square kilometer. The Kutznetsk basin has now been transformed into the country's second mining basin in value and size, after the Donets. About 100 large underground and strip mines are operating here, their annual output exceeding 150 million tons. The basin occupies an area of 26,700 km^2 and stretches in a northeasterly direction for 350 km, with a width of 110 km. Geologically it is a depression, in the northwestern and southwestern (Salair) zones of which intensive folding developed. Along its southern and northeastern edges, primarily a gently sloping monoclinal bedding of rocks is noted. Brachial folded structures of various sizes and steepness of the limbs are encountered in the basin's central regions. The coal-bearing sediments, with a total thickness of 7,000-8,000 meters, are Upper Paleozoic and Jurassic. Operating coal seams numbering 130, with a total thickness of up to 350 meters, have been found. The thickness of some coal seams reaches 30 meters, and they can be excavated by strip mining at the upper horizons.

The basin's importance for diversity of grades of coal and reserves thereof is difficult to overestimate. Especially great is its role as a base for high-quality coking coal, which is so necessary for modern metallurgy. About 45 percent of the explored reserves of coal suitable for coking are concentrated here, of which almost 60 percent are the Zh, K, K2 and OS grades, which are most valuable for the byproduct coke industry. The coking and lean sintering coal, which are marked by a high degree of metamorphism, are confined to sedimentary formations of the Lower Balakhonka series. The less metamorphosed grade Zh coal is associated with Upper Permian formations of the Yerunakovo series and are spread out also in the basin's central regions (see the figure). At the deposits that are formed by rocks of the Yerunakovo series, gas coal also is encountered, a large portion of which can, with the use of special coking methods, serve as byproduct-coke industry raw materials. The inclusion of such coal in coke production is occasioned by the constant rise in the cost of good baking coal that results from a reduction in the reserves and the necessity to work them at deeper horizons and in tectonically complicated deposits. Therefore, already today, the country is building plants to produce foundry coke from gas coal, for use in ferrous and, especially, nonferrous metallurgy.

At the same time, large ferrous metallurgy enterprises are still, as before, oriented to the use of good sintering coal of grades K and Zh, on the basis of which high-capacity production of high-quality coke and the processing of valuable byproducts for the chemical industry have been organized. A shortage of this coal is observed in all parts of the country, including industrially developed regions of the Kuznetsk Basin. The basin's main prospects for mining coking coal, which is in short supply, involve the development of new areas or deeper horizons. Included in the promising regions for fat coal and good gas baking coal are the Leninskoye and Belovskoye regions in the northwestern Salair portion of the basin and the Yerunakovo and Ters' regions in the central and eastern zones, which are formed by sediments of the Yerunakovo series. However, the fact that up to 30 percent of the fat coal reserves of the new deposits that are being prepared for development occur in thin seams--from 0.7 to 1 meters--and are marked by immature structure complicates machine excavation of the coal.

The prospects for mining coking coal that goes into the charge for making metallurgical coke is more restricted in the basin. This is because all the areas in the Prokop'yevskoye-Kiselevsk region that possess the larger reserves of coking coal have already been occupied by the fields

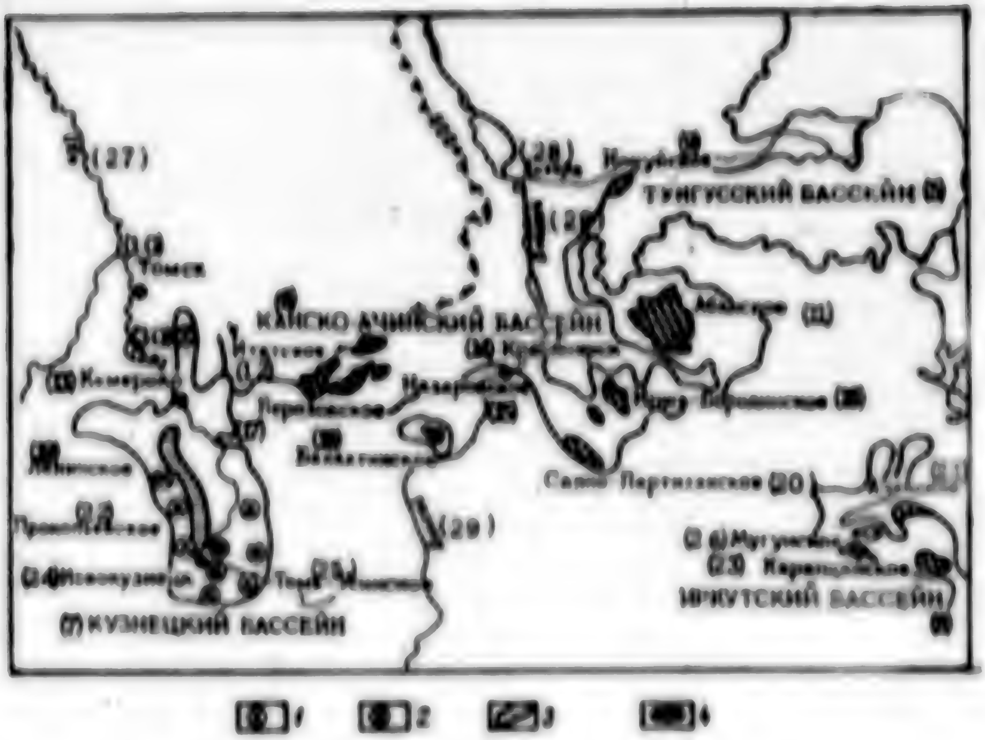

Diagram of the South Siberian Coal Province

Key:

Kuzbass [Kuznetsk Coal Basin] regions [1-4]:

1. With coking coal.
2. With fat coal.
3. Areas with large deposits of coal for power generation and chemical production that are suitable for strip mining or the construction of underground mines.
4. The larger deposits of the Kansk-Achinsk, Tungusska and Irkutsk basins that are accessible for strip mining.

[Transliterations]

5. Tungusska Basin.
6. Kansk-Achinsk Basin.
7. Kuznetsk Basin.
8. Irkutsk Basin.
9. Kokuyskoye.
10. Tomsk.
11. Abanskoye.
12. Itatskoye.
13. Kemerovo.
14. Krasnoyarsk.
15. Nazarovskoye
16. Irsha-Borodinskoye.
17. Berezovskoye.
18. Balakhtinskoye.
19. Leninskoye.
20. Sayano-Partizanskoye.
21. Azeyskoye.
22. Prokop'yevskoye.
23. Karantsayskoye.
24. Novokuznetsk.
25. Tom'-Usinskoye.
26. Mugunskoye.
27. Ob'.
28. Angara.
29. Yenisey.
30. Tom'.

of operating underground mines, and simultaneous excavation of the seams at deeper horizons is impossible because of their steep bedding. At the same time, in another large region--the Tom'-Usinskoye--the potential for mining coking and lean sintering coal still has not been exhausted. Very large underground mines can be built here in the Ol'zherasskoye section and in the Tom' area that was recently discovered in the northwestern part of the region.

At the Ol'zherasskoye section, which is located below the floor of the region's existing underground mines, a group of seams of coal of grades K and K2 with total reserves of about 0.8 billion tons has been identified at depths of 500-800 meters. However, the Tom' area, 60 km^2 in size, attracts special attention. Within it have been found up to 10 gently sloping coal seams from 1.2 to 9 meters thick, with dip angles of 6-12 degrees. Total reserves of the Tom' area at the Tom'-Mras deposit to a depth of 800 meters are 1.9 billion tons, including 1.3 billion tons of coal of coking grades K, K2 and OS. The section is favorable for the construction of superhigh-capacity underground mines with a productivity of 6-8 million tons per year. Exploration is being conducted. In the northeastern part of the region, some other sections with large reserves of high-quality coking coal have been discovered, but they have a complicated geological structure. Fields of coking and lean baking coal are known also in other regions of the basin--in Kemerovo and Kondoma, which are geologically more complex for development. As a whole, the possibilities for further growth in the mining of the scarce K and Zh grades of coal still have not been exhausted in the basin. Mining of the coal can be increased in the near term.

The Kuzbass is exceptionally rich in high-quality steam coal and special industrial coals. Because of the high density of the coal, many of the basin's fields are favorable for excavation by open-strip mining. In recent years, sections with coal reserves of more than 11 billion tons, of which only 2 billion tons are at existing strip coal mines, have been found and partially explored. Deposits and sections have been explored in detail and prepared for the construction of new strip mines with a total capacity of about 75 million tons per year and reserves totaling 9.1 billion tons. The planned capacity of some of the strip mines is 12-15 million tons of coal per year. Mainly, they have been prepared in the central and Leninskoye regions of the basin.

Along with sections for open-pit working of coal, there are coal-bearing areas in the Kuzbass that are exceptionally favorable for the construction of underground mines with superhigh capacities of up to 12-15 million tons per year. Preliminary computations indicate that the operating costs for mining the coal here will be insignificantly higher than for the working of large strip mines. At the same time, underground mining preserves the surface, and there is less destruction of the natural conditions of the environment. Large coal-bearing areas for the construction of superhigh-capacity underground mines with reserves of several billions of tons have been found in the eastern part of the Leninskoye region (the Yegozovo-Krasnoyarsk area) and in other central regions of the basin. Fifteen coal seams of 3-6 meter thickness have been identified here in Yerunakovo-series sediments. The seams lie almost horizontally at depths of 100-600 meters. Most of the basin's deposits that are favorable for the construction of strip mines and superhigh-capacity underground mines contain gas nonbaking coals (G6) and long-flame coal with high heat of combustion--22 to 26 MJ/kg (5,200-6,200 kcal/kg). Vitrinite predominates in the composition of the coal (80 percent). The coals have a comparatively high ash content--from 4 to 15 percent, a low sulfur content--less than 0.5 percent, and a carbon content of 75-80 percent. They are good steam coals and withstand long hauls. A substantial portion of them are suitable for chemical conversion, including liquefaction and gasification.

Enormous solid-fuel raw-material resources have been concentrated in the Kansk-Achinsk basin. The basin is situated to the south of the Siberian platform and the West Siberian lowland, occupying an area of 60,000 km^2. Jurassic coal-bearing formations that lie almost horizontally are observed within its borders. In the latitudinal direction the basin is intersected by the mainline of the Trans-Siberian Railroad for a distance of about 800 km. All the basin's reserves were discovered during the years of Soviet power. To a depth of 600 meters alone they have been assessed at 600 billion tons. Extremely thick coal seams that lie at shallow depths and are accessible for excavation by strip mining are widespread in the basin. The largest number of deposits--the Borodinskoye, Berezovskoye, Itatskoye, Bogotol'skoye and others--are confined to a thick (30-70 meters) coal seam of the Upper Borodinskiy suite, and three deposits--the Nazarovskoye, Abanskoye and Pereyaslavskoye--are confined to an underlying seam (12-15 meters) of the Kamalinskiy suite. In the lowest Makar'yev suite, coal seams up to 5 meters thick have been discovered. The coal of the basin's main deposits are brown, the ash content is 4-12 percent, moisture content is 30-40 percent, and heat of combustion varies from 12.5 to 15.5 MJ/kg (3,000-3,700 kcal/kg). They are included primarily in group B2.

The mining-geology conditions at the deposits where there are thick coal seams are extremely favorable for working by strip mines with a capacity of up to 50 million tons of coal per year, with a stripping coefficient that in most cases does not exceed 2-4 m^3/ton. Explored reserves for these deposits comprise about 70 billion tons, and total reserves for open-cut operations (to a depth of 300 meters) have been identified in the amount of 140 billion tons. Two large strip coal mines with capacities of 16 and 25 million tons per year are already operating in the basin. It is planned to create an industrial Kansk-Achinsk fuel and power complex (KATEK), where new coal enterprises and thermal electric-power stations will be built. Geologists have already prepared areas for the construction of large strip mines with a capacity of about 400 million tons of coal per year. Construction of one of them--the Berezovskoye, where it is planned to mine 60 million tons of coal per year--has begun. According to preliminary estimates, the cost of the coal at these strip mines will be among the cheapest in the country, to be about 2 rubles per ton of standard fuel equivalent, which is 2-fold to 2.5-fold lower than in the Kuzbass.

Mastering KATEK will bring up some most important problems. Among them the following deserve special attention: development of methods for upgrading the fuel with a view to raising its combustion effectiveness, protecting the environment, improving the transportability of the raw material (carbonization at low temperatures, autoclave processing, obtaining thermal coal, and so on); the selection of more economical methods for transmitting electricity and transporting upgraded coal to the country's large industrial centers; the comprehensive use of useful minerals, including the overburden rock, for producing porous agglomerate, and the mining of spherosiderite ore; the development in a region of chemical industries of an industry based on wide coal gasification, and many other problems. Methods for the rational use of Siberia's fuel and energy resources are being developed in order to support industry in the country's western regions. Because of the low quality of Kansk-Achinsk basin coal, which contains 30-40 percent moisture at the main deposits, transporting it in unrefined form over long distances is not rational. It is probably more desirable, along with constructing KATEK, to develop the mining of high-quality power-plant coal in the Kuzbass for shipment to the west and to use Kansk-Achinsk coal more widely in Siberia's economy.

The problem of obtaining liquid fuel based on inexpensive coal of the Kansk-Achinsk, Kuznetsk, Irkutsk and other Siberian basins is one of the most urgent problems of the near term. Because of the enormous growth in requirements for liquid fuel and the sharp rise in the cost of oil on the world market, the most rapid development and introduction of effective methods for obtaining liquid fuel synthetically are necessary. Work in this area is being done in the USSR, the U. S., the FRG, Great Britain, Poland and other countries. The November 1979 CPSU Central Committee Plenum pointed out the necessity for long-range plans that call for wide development of work to produce synthetic liquid fuel. President of the AN SSSR [USSR Academy of Sciences] Academician A. P. Aleksandrov noted that, as a result of the rise in prices for crude oil and the reduction of oil's importance in the fuel balance, /"the shortage that is being formed will be covered through an increase in the exploitation of coal deposits and an expansion of the share of nuclear power, the increase in the use of coal apparently being associated with the preliminary processing of coal into liquid and gaseous fuel, since the direct combustion of coal involves the discharge of large amounts of sulfurous gas and other substances that are injurious to the environment." [italics]/*

In the opinion of staff workers of the Institute of Mineral Fuels, which is carrying out major experimental work on the liquefaction of coal, the method developed in the USSR for hydrogenating coal with the addition of about 30 percent crude oil to obtain hydrogen and the introduction of a molybdenum catalyst is still the most effective method.** The use of crude oil permits pit coal and brown coal to be converted sufficiently completely into liquid products--up to 90 percent. In order to produce liquid fuel, coals from grade B2 brown coal to Zh grade fat coal, which are characterized by a vitrinite reflectivity of 0.35-0.95 percent and a carbon content of 68-85 percent, are suitable. The coals should be low-ash (less than 6 percent) with a fusinite content of less than 6 percent, a hydrogen content of at least 4.5 percent and a carbon-to-hydrogen ratio of no more than 16.* Gas and long-flame Kuznetsk basin coals and medium-carbon rank brown coals of the Kansk-Achinsk basin that have been prepared for development correspond basically to the requirements set forth. Apparently, in the long term the largest centers for producing synthetic liquid fuel will be established in these regions.

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*IZVESTIYA, 3 May 1978.

**Krichko, A. A. Galkina, A. A., Titov, T. A. and Pchelina, D. P. "The Hydrogenation of Coal--Its Status and Prospects," KHIMIYA TVERDOGO TOPLIVA [Chemistry of Solid Fuels, No 4, 1978, pp 53-63.
Krichko, A. A. "Problems of the Comprehensive Use of Coal," KHIMIYA TVERDOGO TOPLIVA, No 6, 1977, pp 3-10.

The coal resources of West and East Siberia are far from being exhausted by the Kuznetsk and Kansk-Achinsk basins. To the east of the latter stretch the Irkutsk basin, with brown (B3) and long-flame coals that occur mainly in almost horizontal seams, which are of the Jurassic. The overall geological reserves of the basin, which occupies an area of 43,000 km^2, has been appraised at 76 billion tons, of which 12 billion tons have been explored for open-pit mining and are being developed partially by strip mines. However, an increase in coal mining in the basin is being hampered considerably because of the high sulfur content in the deposits with the greatest promise, where thick seams (the Karantsay and Novometelka) have been found. At some sections of these deposits the sulfur content in the coal runs to 6-8 percent. Considering the great need of the country's eastern regions for sulfur, it is desirable to examine the question of the comprehensive use of the basin's sulfurous coal by preliminary gasification, with scrubbing of the sulfurous gases.

Along the northern border of the eastern half of the Kansk-Achinsk basin stretches the southern boundary of the Tungusska basin, whose enormous coal reserves have been studied relatively poorly and do not yet interest industry because of unfavorable mining-geology conditions. However, Angara areas with Permian-age coal deserve a more detailed study and probably can be drawn into KATEK. The large, partially explored Kokuyskoye deposit here, at which a coal seam about 60 meters thick has been discovered that forms a curve of a synclinal fold and has reserves of more than 300 million tons, is suitable for open-cut excavation. Long-flame pit coal whose ash content reaches 10 percent and heat of combustion is 17.5 MJ/kg (4,200 kcal/kg) has been identified. The southern edge of the Tungusska basin is promising for searches for pit-coal and Permian deposits similar to those of Kokuyskoye. Other Siberian coal basins are less effective for involvement in the sphere of large-scale industrial production.

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*Yeremin, I. V., Zharova, M. N. and Skripchenko, G. B. "The Substantive Makeup, the Structure and Properties of Mineral Coals in Relation to Their Processing into Liquid and Gaseous Fuel." KHIMIYA TVERDOGO TOPLIVA, No 4, 1978, pp 22-28.

The byproduct-coke industry is experiencing major difficulties in all countries of the world. The cost of high-quality coking coal is rising rapidly, and reserves are being reduced. Our country's western regions also are beginning to experience difficulty in supplying coking coal. Therefore, not only in the Kuzbass but also in other promising Siberian regions, the search for deposits of good sintering coal must be speeded up in every possible way. Such regions should include, primarily, the Taymyr basin, with coal of Permian age, which is in the Far North. According to preliminary data, the basin contains substantial reserves of coking coal. It is situated in direct proximity to the Northern Sea Route, which considerably simplifies the possibility for moving the coal out. The creation in northern Siberia of a second large base for coking coal will be of great national economic importance. Siberia's coal wealth is truly enormous. The task of the Soviet people is to use these colossal riches completely for the benefit of our motherland.

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